Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 71 YEARS

February 17, 1945 — Vol. 123, No. 7

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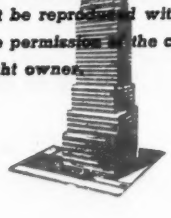

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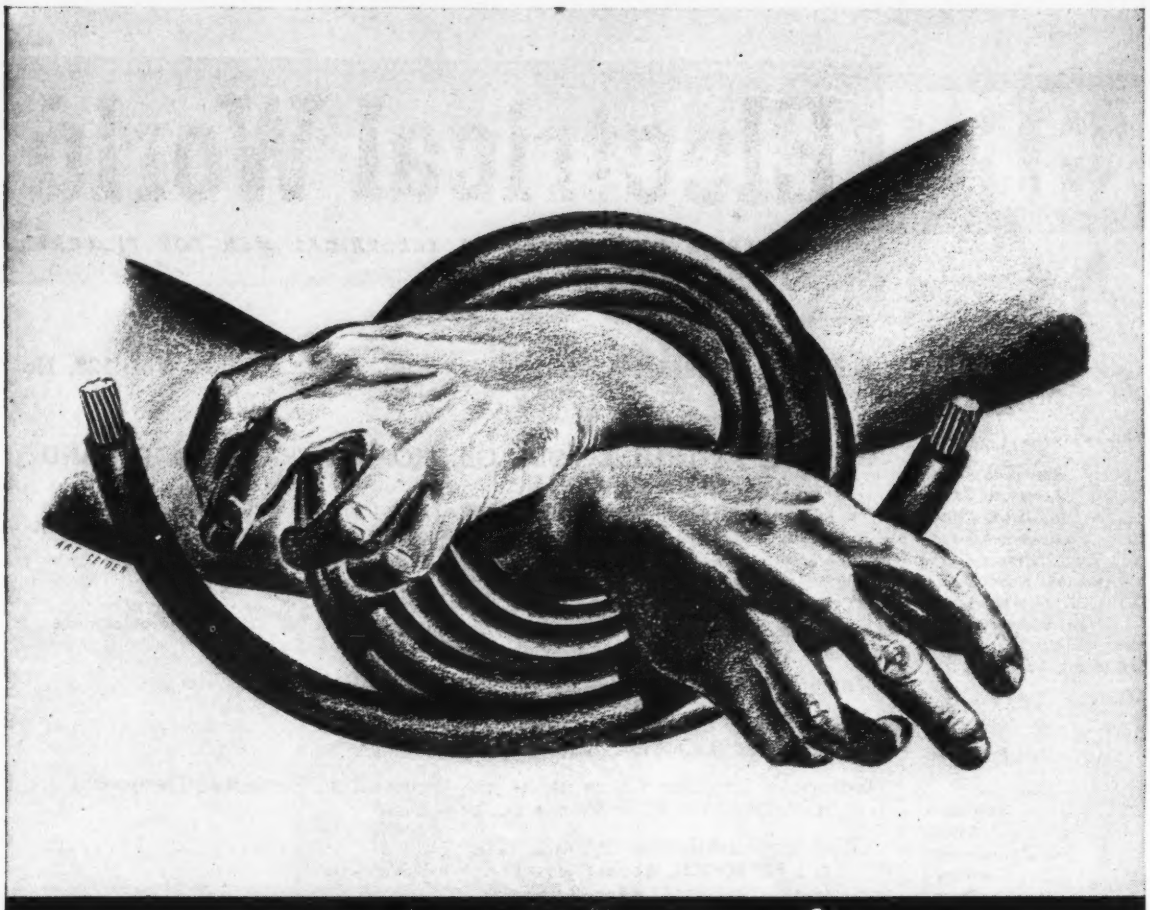

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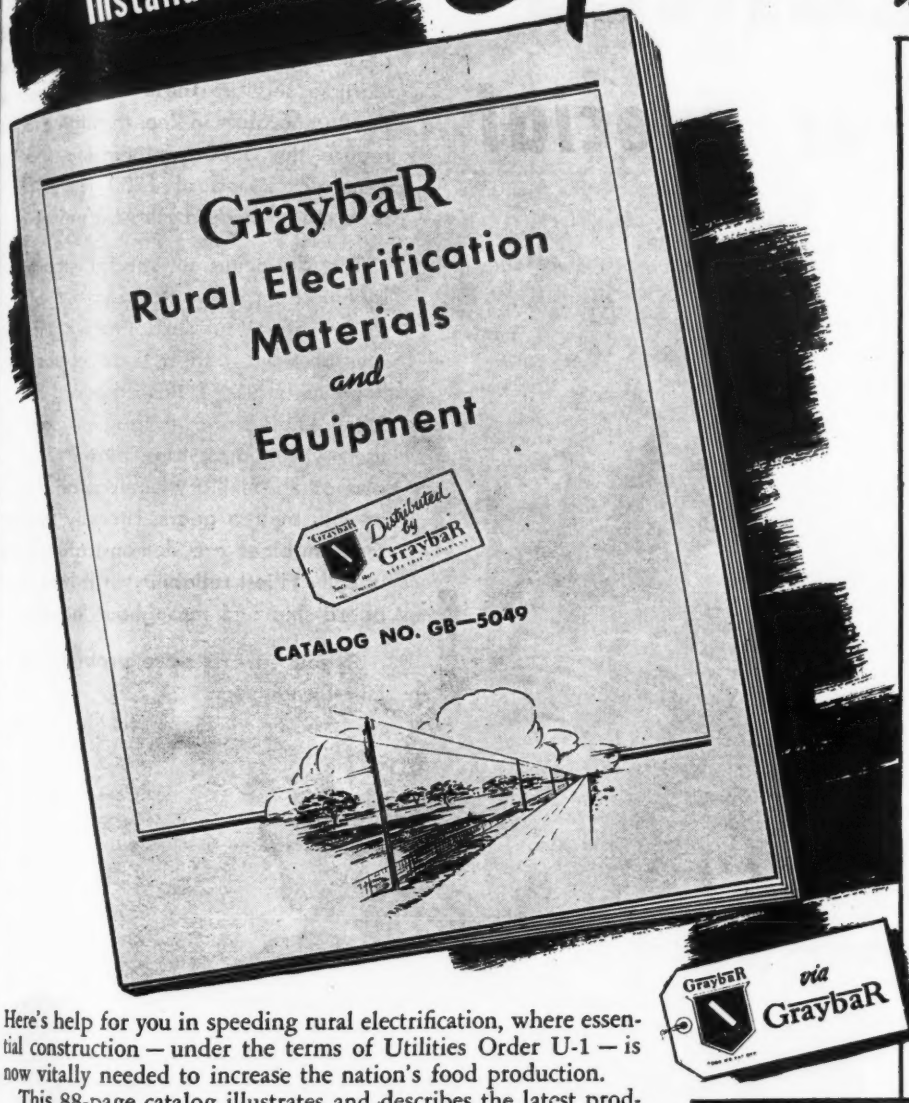

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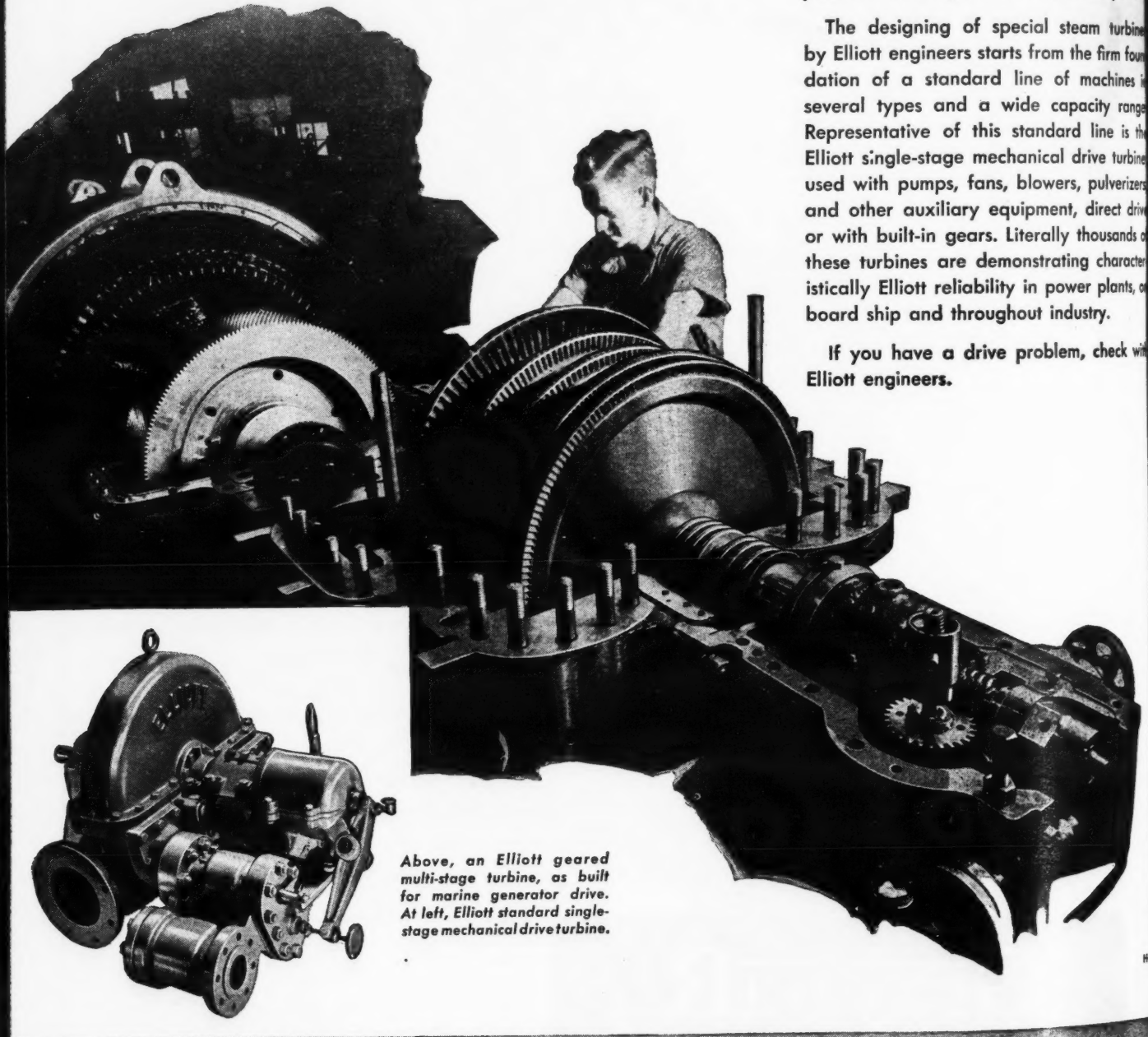
If you have a drive problem, check with Elliott engineers.



Above, an Elliott geared multi-stage turbine, as built for marine generator drive. At left, Elliott standard single-stage mechanical drive turbine.

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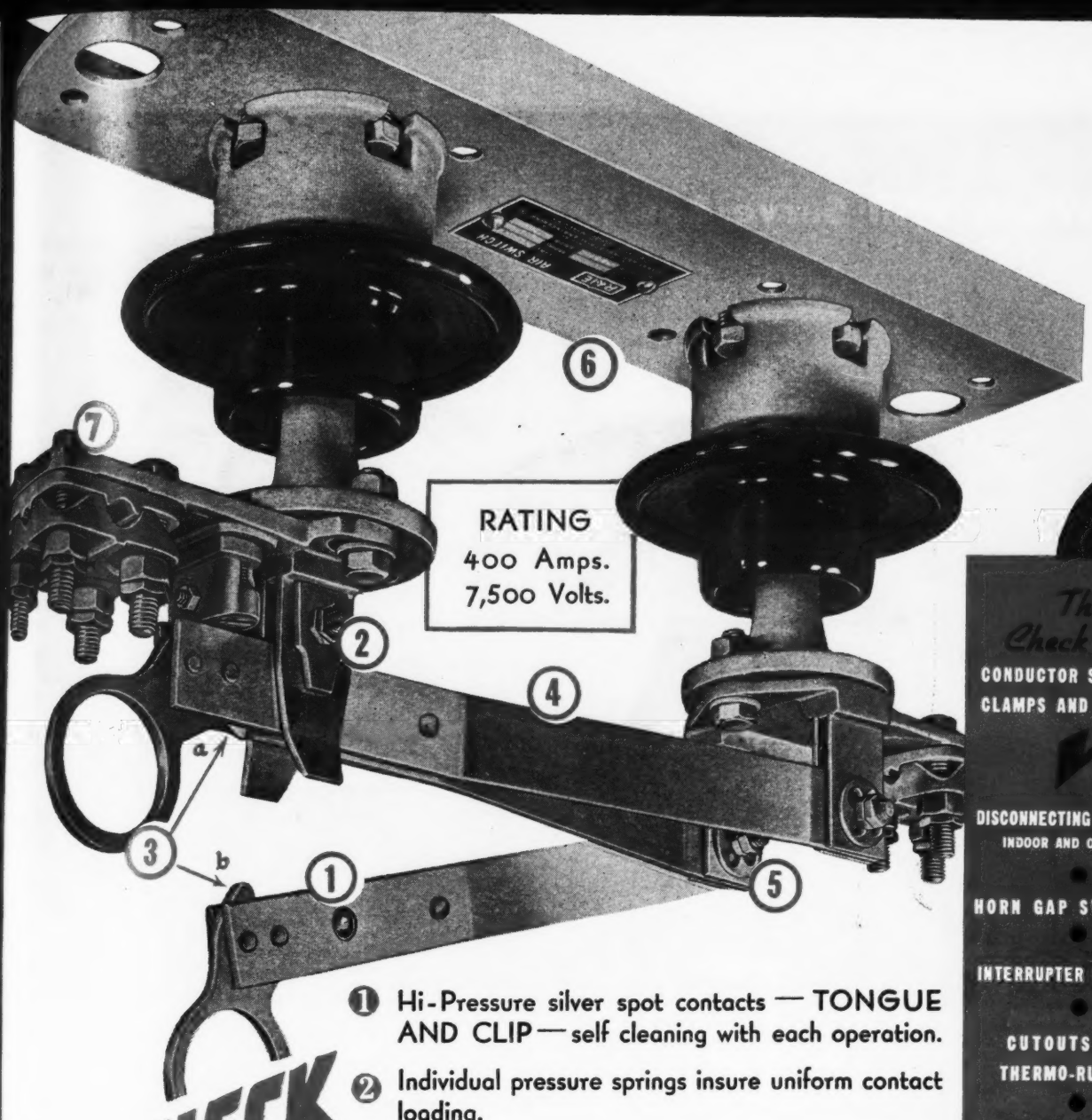

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2. Individual pressure springs insure uniform contact loading.
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7. Clamp type, adjustable terminals with four half-inch bolts.

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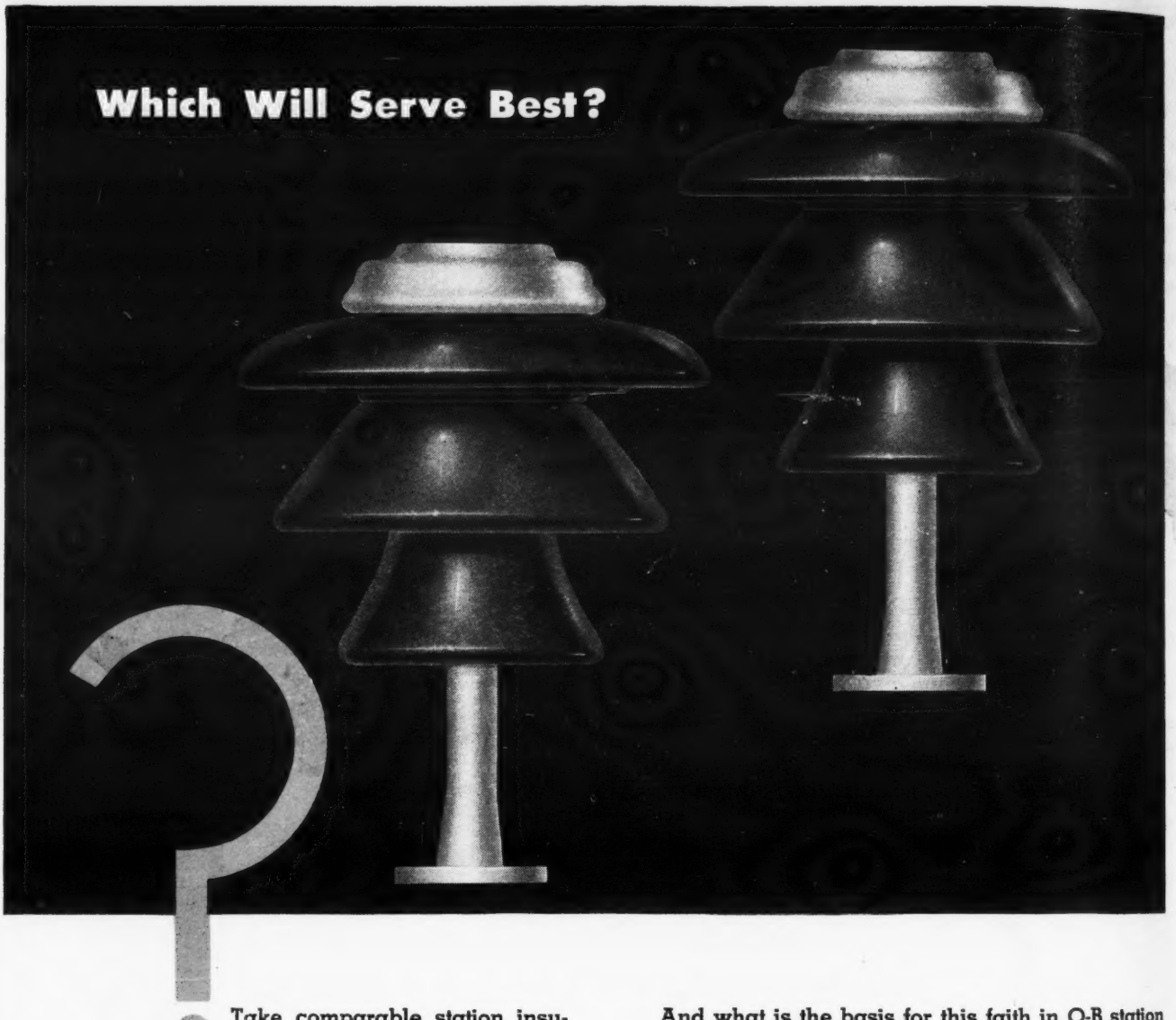
IN CANADA—EASTERN POWER DEVICES, LIMITED, TORONTO



Take comparable station insulators of any two manufacturers and they look very much alike. Test them. They test alike both electrically and mechanically. Can we infer from this that they actually are just alike? Do the standards under which they are all built assure uniform results in service?

One thing that testing a new insulator out of stock cannot reveal is future performance, measured in terms of 30 years or more. The occurrence of heat, cold, climatic changes, and mechanical loads cannot be reproduced in the laboratory in proper sequence and combination, along with the element of time lapse. Simulated or accelerated tests are, at best, only indicators. If you want to know how your selected station insulator will be performing 30 years from now, it will take 30 years to find it out for sure; and an unfavorable answer may come to you long after it is too late to do anything about it. Frankly, the most important thing - reliability - is still bought on faith.

And what is the basis for this faith in O-B station insulators? Just this. Thousands of 30-year-old O-B units are still performing in vital spots today. These are the forefathers of a family now multiplied many hundred fold. Design refinements have been made which should improve this known performance.

Authentic service records that cover large numbers and long time, and that are open to the prospective buyer, are not claims but facts! They are proof of that quality of reliability that can't be covered in a set of specifications. When you buy O-B, you get everything that can be specified, plus that which cannot -- long, trouble-free service.

2596-H

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And that's the test that has proved Allis-Chalmers motors are *great* motors. That's why you hear it said so often: *"You can depend on Allis-Chalmers Motors!"*

Yes, hundreds of Allis-Chalmers men—*quality* men like Bill Seebode — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a friend . . . and they know that's something no company and its workers can have too many of. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

• • •

♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

A 1729

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

Customer's Choice?

Allis-Chalmers believes in the cooperative of buyer preference—thus offers you not

☛ Among the questions which a manufacturer must decide in developing equipment for industry is to what extent it should be standardized.

☛ When practicable, standardization results in undeniable benefits by making possible a better product at a lower price. On the other hand, too rigid standardization may be unfair to the users of the equipment.

☛ Allis-Chalmers introduced standardized metalclad switchgear to America — and has standardized breakers dimensionally to fit in metalclad units.

☛ What Allis-Chalmers has *not* yet done is to restrict buyer choice of types of circuit interrupters available . . . either by price penalties or any other means.

☛ Back of Allis-Chalmers' policy on switchgear standardization is the sincere conviction that customer preference is tremendously important.

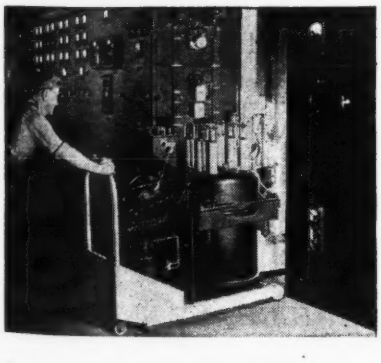
ALLIS AC CHALMERS

Or Manufacturer's?

development of switchgear, along the lines one, but three types of circuit breakers.

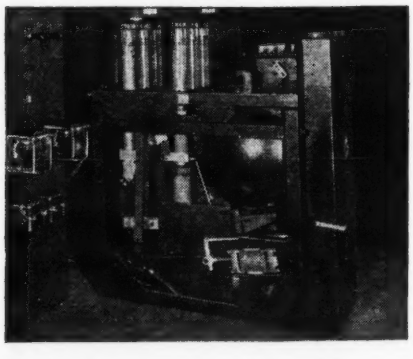
☛ By offering all three types of circuit interrupters for unrestricted buyer choice, Allis-Chalmers lets the customer bring to bear on evolution of switchgear his own knowledge of local conditions. Thus the circuit breaker (or breakers) offered tomorrow will be the result of cooperative development by manufacturer and customers today.

The 3 Types of Allis-Chalmers Circuit Breakers



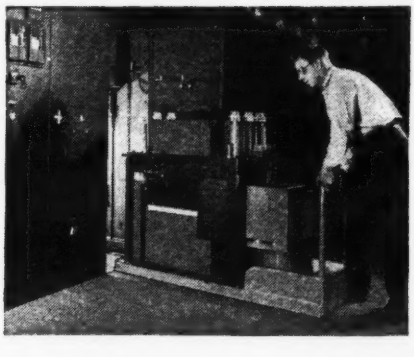
1 OIL CIRCUIT BREAKER

As offered by Allis-Chalmers, this breaker is the product of 40 years' development and research. It is "Ruptor"-equipped for low maintenance. High impulse strength and its desirable application in certain atmospheric conditions promise to keep the oil breaker a factor in the electrical industry.



2 AIR BLAST BREAKER

First commercially introduced to this country by Allis-Chalmers six years ago, the air blast breaker gives unexcelled all-around performance. Arcing time is always within one-half cycle, with longer contact life as a result. The breaker is ideally suited for repetitive duty at high currents.



3 MAGNETIC AIR BREAKER

This new breaker is gaining popularity among operators for moderate capacity installations, 5 kv and below. Fire hazard is reduced, handling of oil eliminated. Contacts in the Allis-Chalmers "Ruptair" magnetic air breaker are accessible for inspection and maintenance without disturbing the arc chute.

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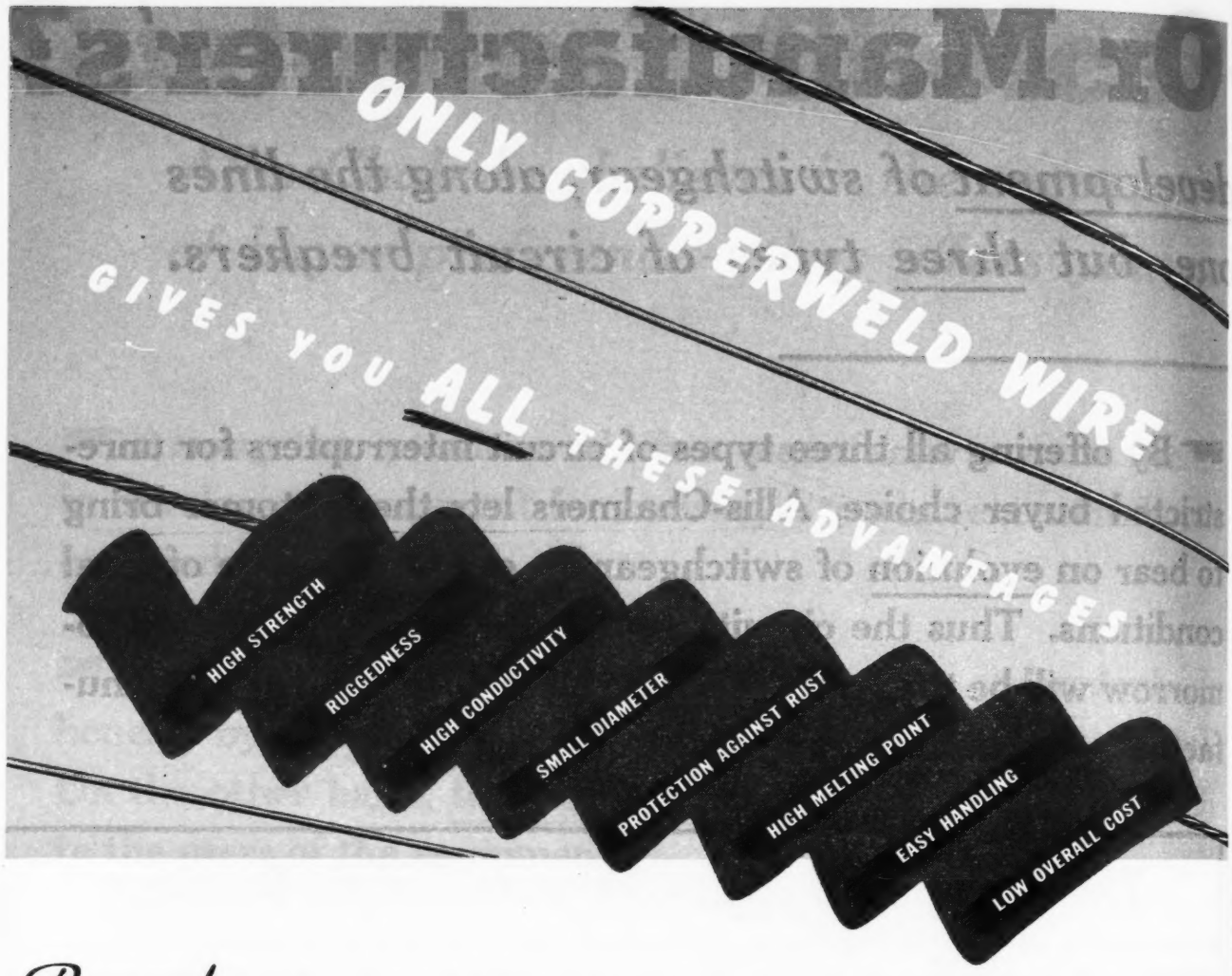
A 1821



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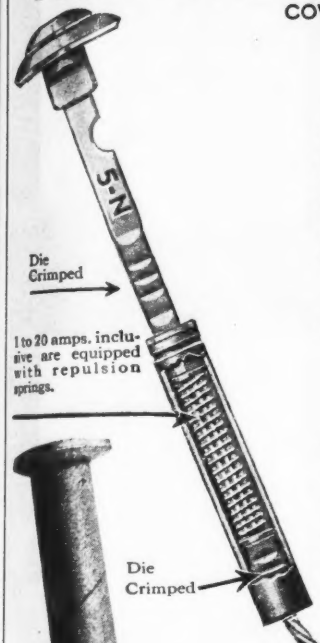
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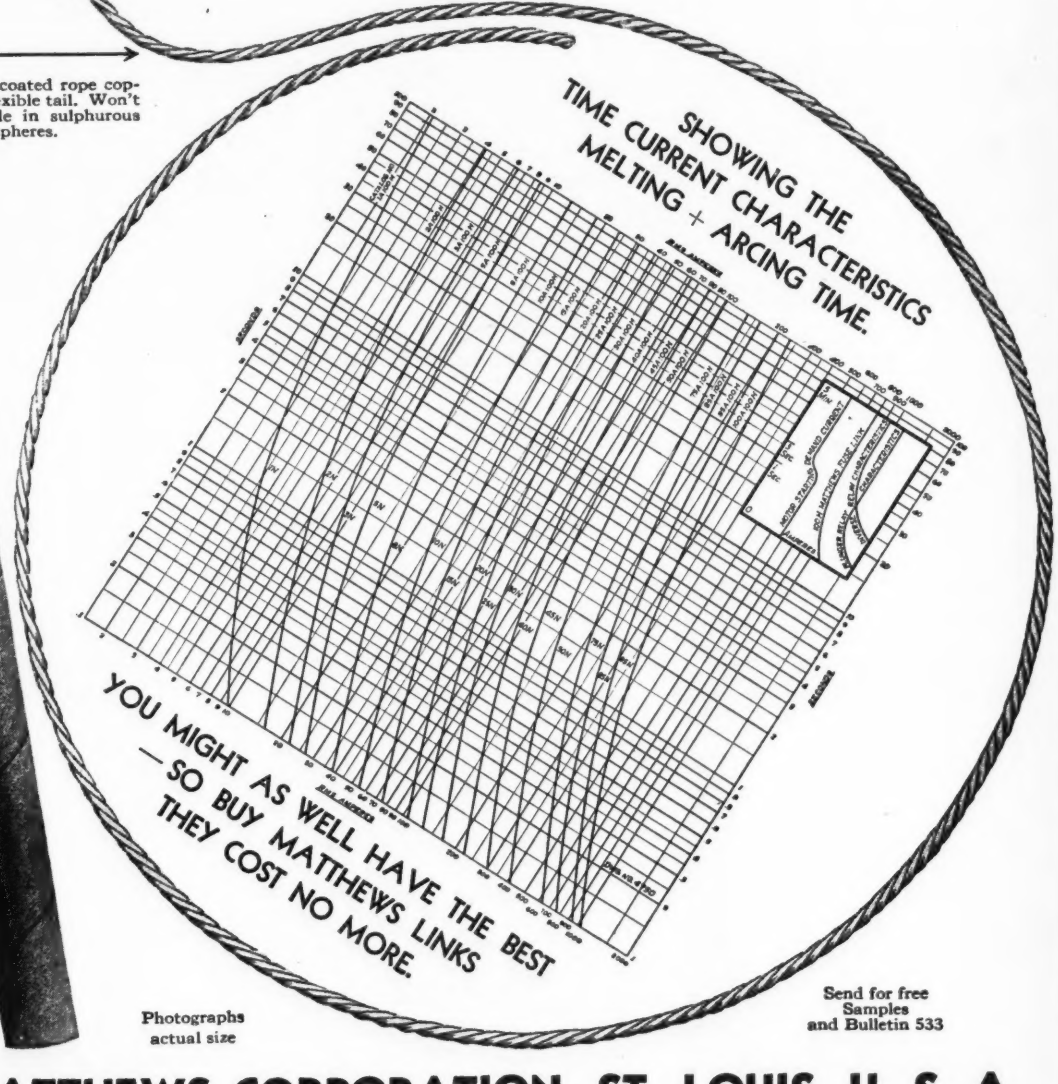
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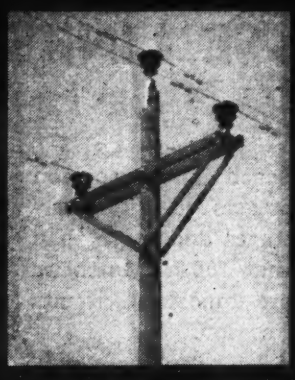

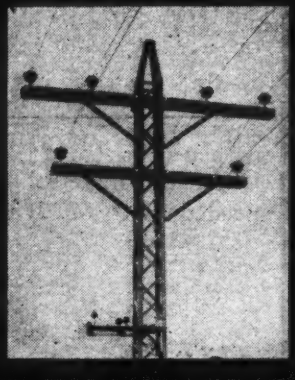

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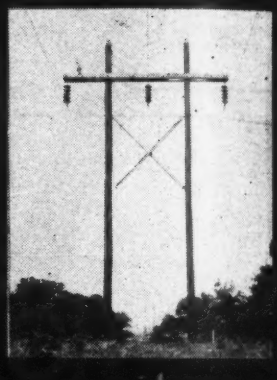

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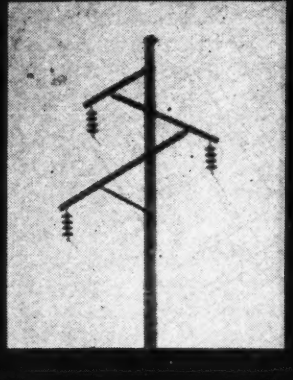

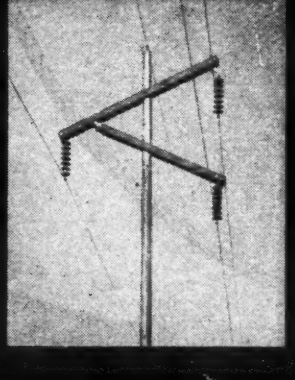

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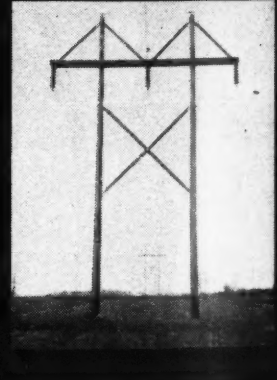

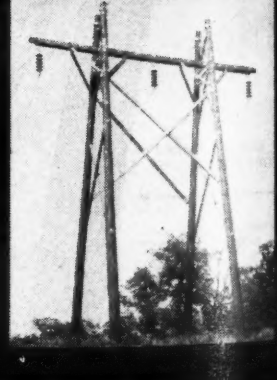

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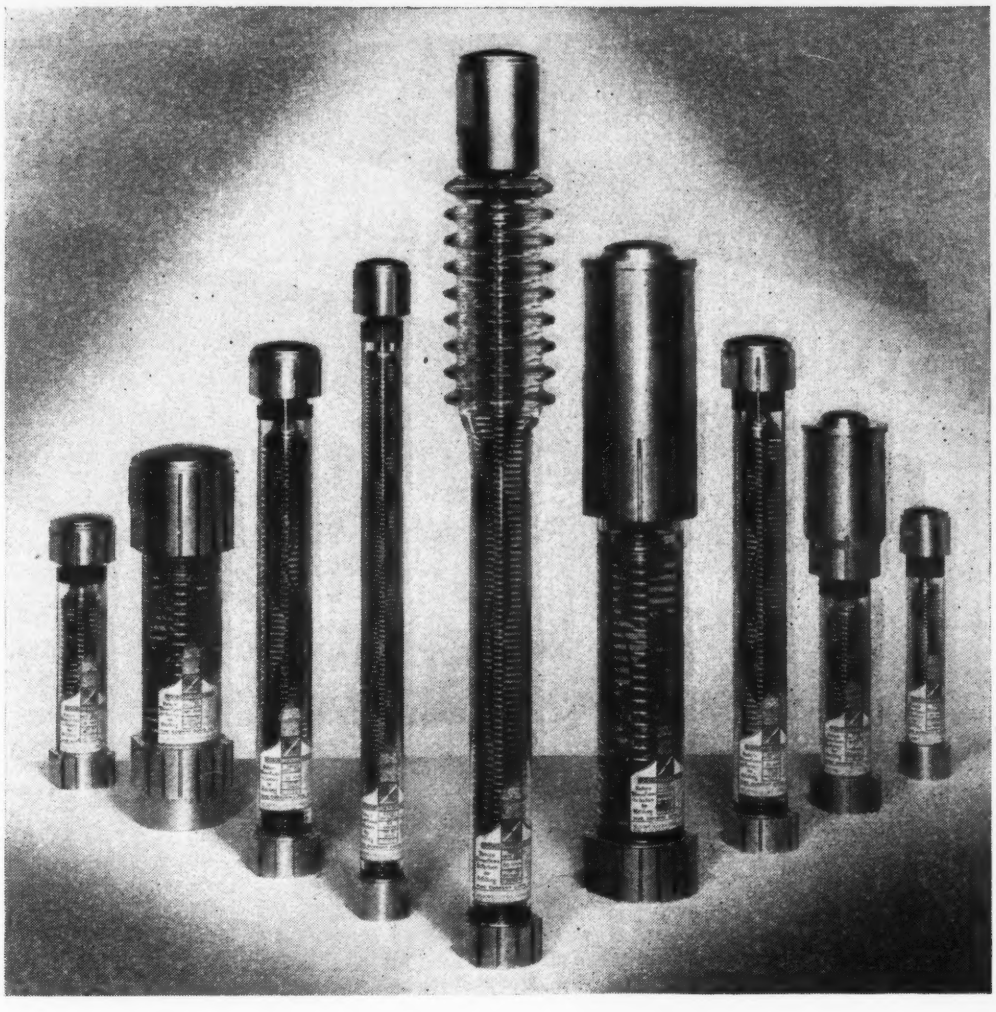

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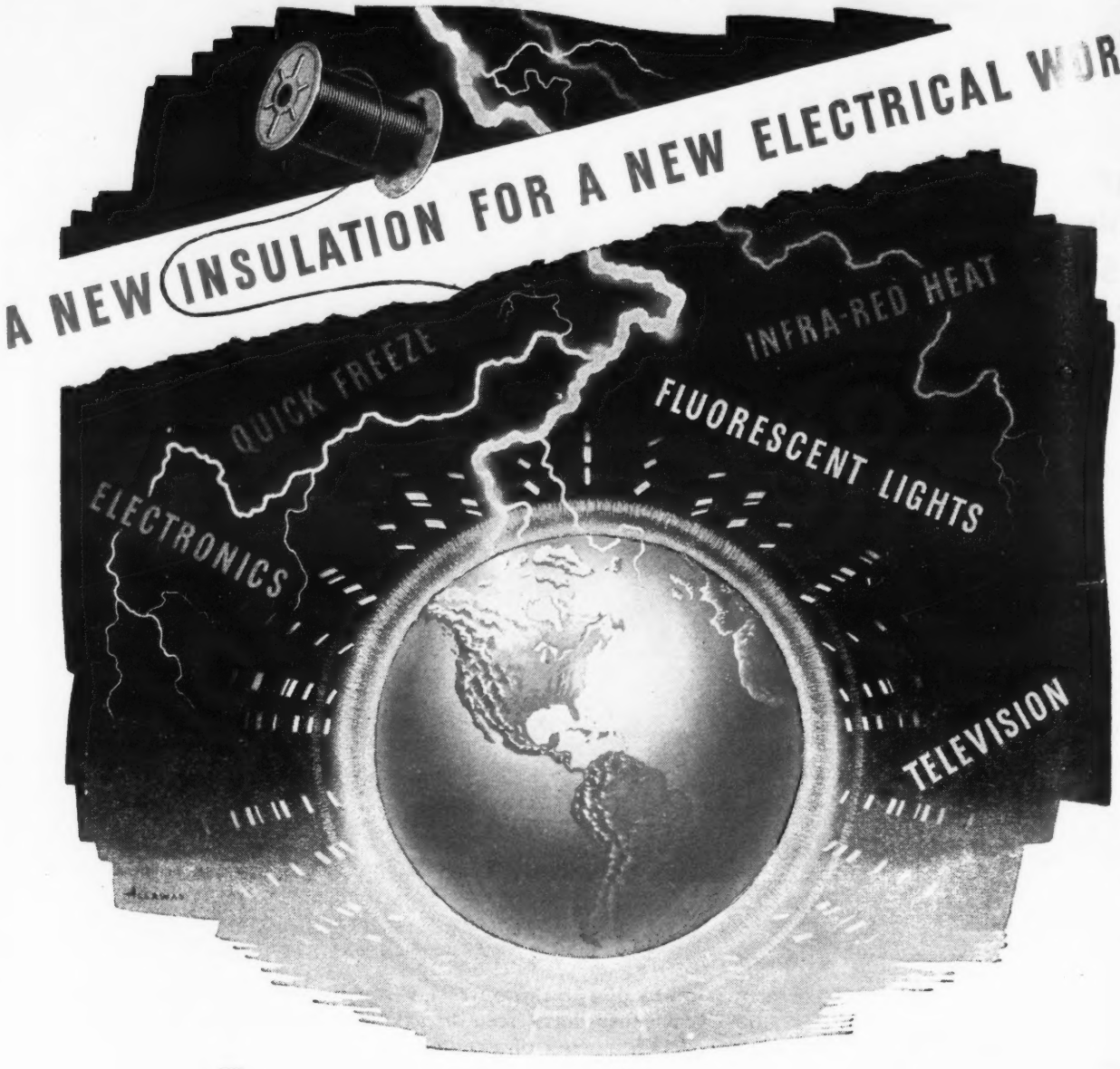
1. Visual indication at all times—blown fuses can be seen from the ground without removing them.
2. Accurate time current characteristics—for coordination with other protective devices—the most accurate fuses made.
3. Long life—fuse elements are made of pure silver—do not corrode or fatigue.
4. Fast clearing time under all values of fault currents up to maximum interrupting capacity.
5. Proven reliable performance throughout years of service.

Continuous improvements over the years have made these fuses today the most accurate and dependable for high current interrupting ratings. Write for Bulletin 200B.

SCHWEITZER & CONRAD, INC.
4421 Ravenswood Avenue, Chicago 40, U. S. A.
Represented in Principal Cities (Consult Telephone Directory)
In Canada by Powerlite Devices, Ltd., Toronto, Ont



nubun

Serving Through Science

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony program. CBS network, Sunday afternoon 3:00 to 4:30 E.W.T.

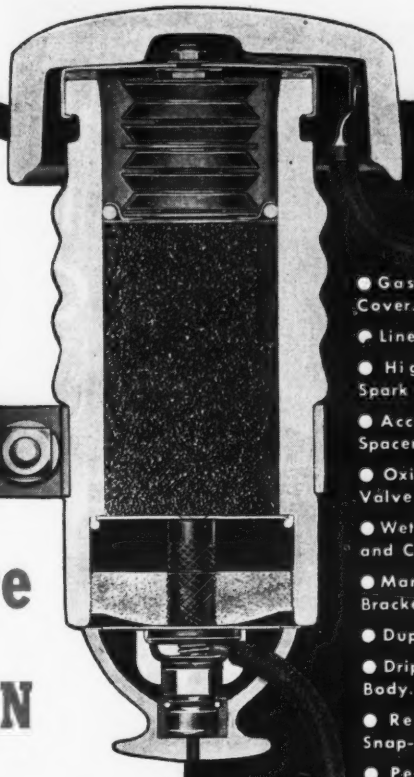
Tomorrow's world will witness countless new home benefits from electricity. In the kitchen, new quick-freeze refrigerators and new infra-red, deep-heat stoves—throughout your house, new high-frequency lighting, new FM and television radios. And to deliver electricity for this, not the ordinary wire of today, *but a new wire, with new and higher electrical standards will be required.*

Scientists have pioneered a better insulation for just such a wire. Through research that stems from the rubber molecule itself, and through precise methods of production, United States Rubber Company has developed Nubun...a new buna rubber insulation, flexible, moisture-resistant, tough—safe. Nubun is applied by the unique dipped process that permits perfect centering of the wire and a diameter smaller than any now commercially available.

UNITED STATES RUBBER COMPANY

1230 Sixth Avenue, Rockefeller Center, New York 20, N. Y. • *In Canada:* Dominion Rubber Co., Ltd.

IMPORTANT FEATURES OF Crystal Valve CONSTRUCTION



- Gasketed Copper Sealing Cover.
- Line Lead Moisture Shield.
- High-Speed Multi-Gap Spark Gap Structure.
- Accurately Ground Steatite Spacers and Support.
- Oxidized Silicon Carbide Valve Element.
- Wet Process Porcelain Body and Cap.
- Many Types of Mounting Brackets.
- Duplex Ground Seals.
- Drip Petticoats on Cap and Body.
- Removable Cover With Snap-On Lock.
- Perfected Ground Wire Clamp.

. . . RESULT IN ARRESTERS GIVING YOU

Heavy Duty **high surge discharge capacity.**

High Speed **low impulse breakdown voltage.**

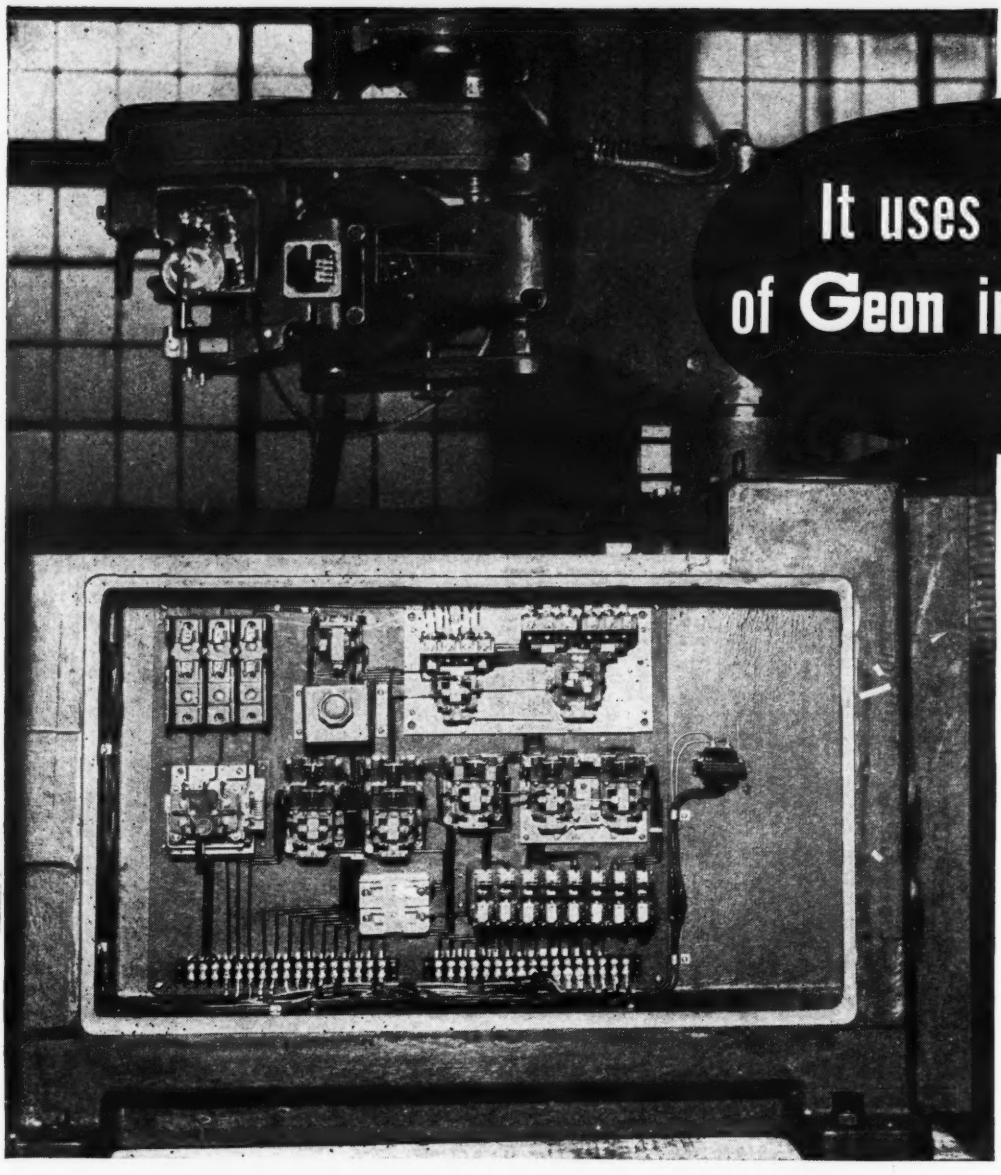
True Valve Action **for follow current interruption.**

Low IR Drop **— surge voltage reduction.**

Low Maintenance **and long life.**

ELECTRIC SERVICE MANUFACTURING CO. • 17th & CAMBRIA STS., PHILADELPHIA 32, PA.

CRYSTAL VALVE LIGHTNING ARRESTERS



It uses 1900 feet of Geon insulated wire

THE picture shows you part of the 1900 feet of electrical wire that go into this *modern* tapping machine—*modern,* to give one reason, because every inch of the wire insulation is made from one of the GEON polyvinyl materials.

GEON is used because, in addition to possessing unusual electrical properties, it resists oil and oil fumes. It resists flame—is, in fact, self-extinguishing. It resists the heat of service conditions. It's smooth—permits easy handling and installation. It can be brilliantly colored in the entire NEMA range for easy, positive identification.

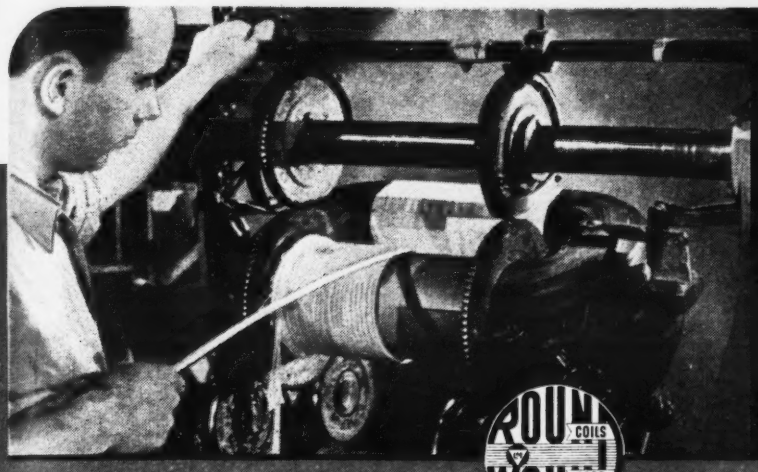
Because of GEON'S outstanding electrical properties, the coating of insulation can be much thinner—more conductors can be run in each conduit. GEON is waterproof, acidproof, airproof, wearproof. It can be made into "spaghetti" to slip on fine radio or switchboard wire. Or it can be extruded onto heavy-duty underground power cable.

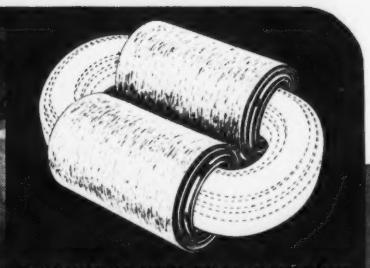
Right now all the GEONS are subject to allocation by the War Production Board. But limited quantities can be had for experiment. And soon, increased production will permit much broader use of these important materials. Meanwhile, our development staff and laboratory facilities are available to help you work out any special problems or applications. For more complete information write Department CC-2, Chemical Division, The B. F. Goodrich Company, 324 Rose Building, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

CHEMICAL DIVISION
THE B. F. GOODRICH COMPANY
ROSE BUILDING, E. NINTH & PROSPECT, CLEVELAND 15, OHIO

How one L-M idea solved several transformer problems





ADVANTAGES OF ROUND-WOUND CONSTRUCTION

1. Improved regulation at *all* power factors
2. Better ratio of losses
3. Uniformly low exciting current
4. Uniformly high impulse strength
5. High short-time overload capacity

L-M Round-Wound transformers are available in 1½ to 25 Kva., 2400 to 7620 volt rating. Meet all EEI and NEMA standards.

ROUND WOUND COILS CORE

For years, high core loss, high exciting current, and other undesirable characteristics were considered unavoidable in distribution transformers. These were the direct result of built-up, laminated cores, with their air gaps, square corners, and right angle changes of grain and flux direction; short rectangular coils made to slip on over the rectangular core legs; and uneven cooling and hot spots. These factors were part of the only practical construction method then known.

Spurred by competition, designers strove to improve their methods—to secure the recognition of increased sales that a better product wins; and to render a service to their customers and the industry.

In this contest for product improvement, Line Material was in a fortunate position. It did not need to diversify its research over a long line of products. Yet, being much larger than smaller specialist companies, it was well able to finance a long-time research program.

In fact, for many years Line Material had maintained well-equipped laboratories and a staff of research engineers, many of them with practical field experience.

The result, in brief, was the Round-Wound Transformer. With the core WOUND with the grain, in an ellipse, under tension, without air gaps, this design reduced core loss and exciting current substantially. An ingenious method of winding coils right onto the core made it possible to leave the core undisturbed after annealing; made possible the long ROUND coils, enveloping a maximum of the iron circuit.

Round-Wound construction not only solved the problem of core loss, but also gave far greater efficiency in other respects—better cooling, better regulation at *all* power factors, higher impulse strength, and greater short-time overload capacity.

For the whole story, ask the Line Material Field Engineer for a copy of illustrated Bulletin RW-421; call or write the nearest L-M branch office or Line Material Company, Milwaukee 1, Wisconsin.

LM

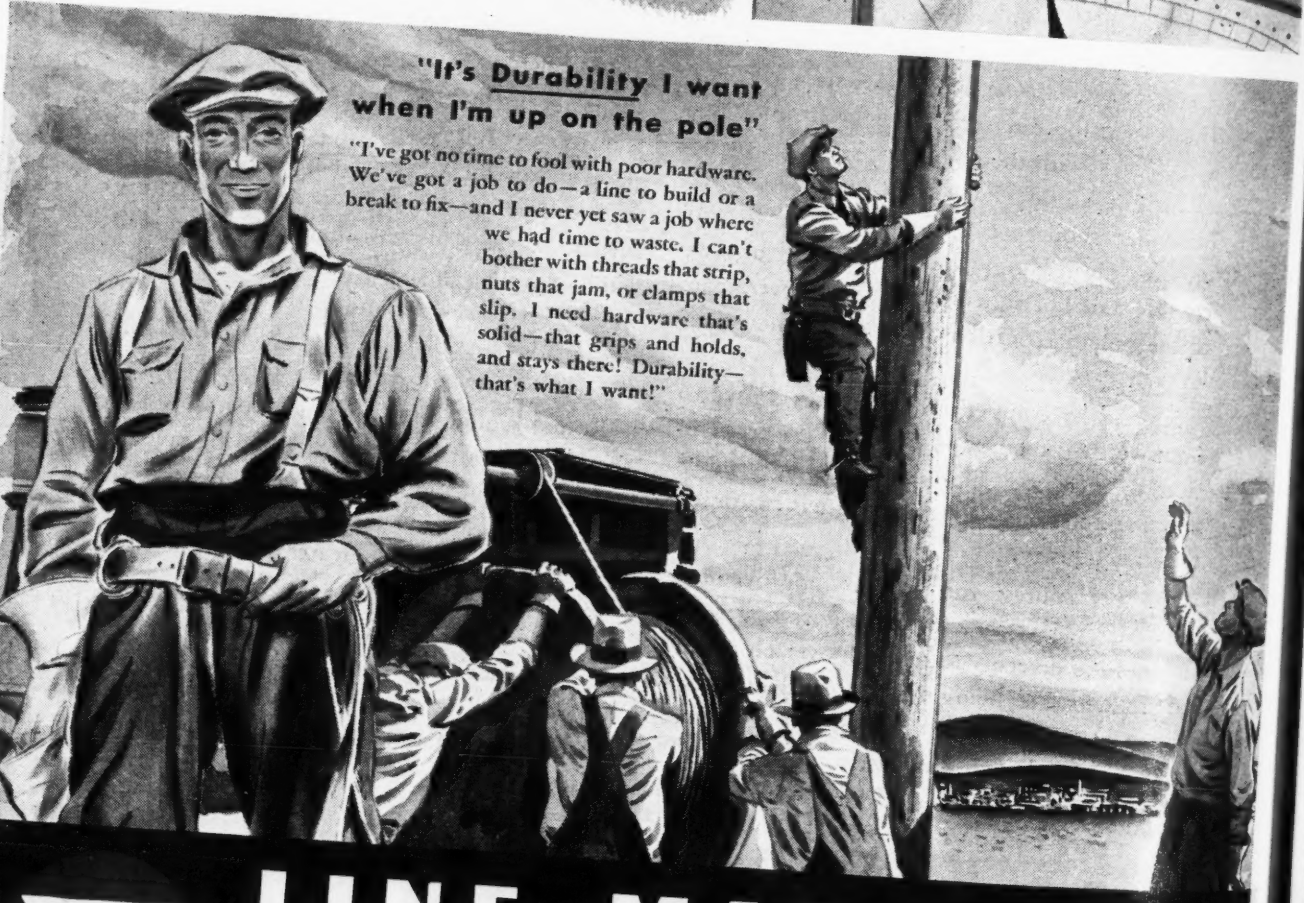
LINE MATERIAL

TRANSFORMERS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

"Buy Pole Line Hardware by the pound?"

That was the old idea—pole line hardware was so much steel—so many pounds of bolts and nuts and clamps. Today distribution men place tremendous stress upon the quality of the pole line hardware they use. They recognize that pole line hardware isn't like so much "sugar and salt", to be bought by weight. They know the job it must do—the trouble that faulty hardware can cause—and the cost of such trouble in lost man-hours and lost kilowatt-hours. That's why so many men now specify L-M Pole Line Hardware.



"It's Durability I want when I'm up on the pole"

"I've got no time to fool with poor hardware. We've got a job to do—a line to build or a break to fix—and I never yet saw a job where we had time to waste. I can't bother with threads that strip, nuts that jam, or clamps that slip. I need hardware that's solid—that grips and holds, and stays there! Durability—that's what I want!"

LM

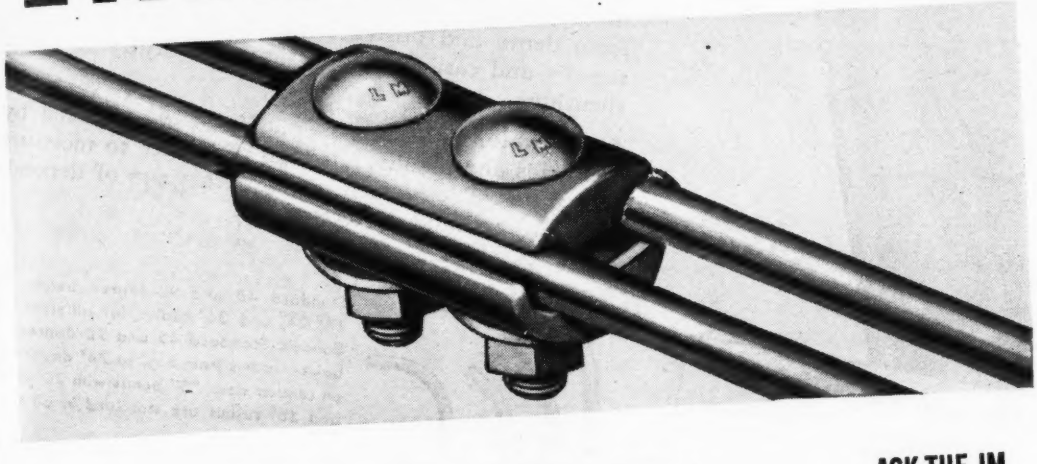
LINE MATERIAL
POLE LINE HARDWARE

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers • Fuse Cutouts and Fuse Links • Lightning Arresters Oil Switches • Pole Line Hardware • Line Construction Specialties • Underground Equipment • Fibre Conduit • Street Lighting Equipment

"SURE—by the pounds of strain it withstands!"

In a recent series of interviews with engineers and superintendents of distribution, 72% of the men said "Durability" was their primary requirement for pole line hardware. "Strength" . . . "Dependability" . . . "Will it hold?" . . . "Will it stand up?"—That's what they ask about hardware. Line Material knows what these men need—meets their requirements with good design; strength of material; firm, clean-cut threads; full protection of hot-dip galvanizing. Men who know, specify and depend on L-M Pole Line Hardware.

L-M Double Groove Clamps



(From L-M Catalog, Page 8-016A—Pole Line Hardware)

L-M double bolt, double groove clamps can be used for aluminum-to-aluminum, aluminum-to-copper, and copper-to-copper connections. Available in aluminum, copper, or bronze clamp casting, all with galvanized steel ½-inch—13 x 2½-inch carriage bolts and nuts. Aluminum clamps fit A.C.S.R. sizes 6 to 4/0 on line and tap sides; with copper liner from 8 to 2/0 A.W.G. on tap side. Copper and bronze clamps fit sizes from 6 to 250,000 CM.

	Line Side	Tap Side
	& Armor Rod	Copper A. W. G.
		Max.

ASK THE LM FIELD ENGINEER!

This man is experienced, capable, can give you practical, valuable help. Call or write nearest L-M office or Line Material Co., Milwaukee 1, Wis., today.

LINE MATERIAL
POLE LINE HARDWARE

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers · Fuse Cutouts and Fuse Links · Lightning Arresters · Oil Switches · Pole Line Hardware · Line Construction Specialties · Underground Equipment · Fibre Conduit · Street Lighting Equipment

L-M FIBRE CONDUIT

provides faster installation longer protection... for these 6 reasons

1. Lightweight. L-M Fibre Conduit weighs only 1½ pounds per foot of 3″ conduit. It is easy to carry, and saves time and labor in hauling and handling.

2. High wall strength. The strength and toughness of L-M Fibre Conduit keeps breakage at a minimum, thus reducing delays and expense for replacement.

3. Uniform in size. Uniformity in measurements of length, bore, wall thickness, and joints, is important, because it means that L-M Fibre Conduit can be laid rapidly without loss of time for realignment.

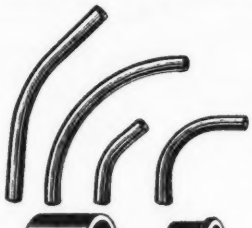
4. Watertight at joints. L-M Fibre Conduit can be laid immediately, without danger of seepage into joints from wet concrete.

5. Smooth, round inside surface. L-M Conduit is made within ⅛″ of round and diameter, and is free from dents and obstructions. Cable can be drawn rapidly and easily without danger of injury to cable sheathing.

6. Durable. L-M Fibre Conduit is not affected by soil acids and alkalis; has high resistance to moisture and water. Therefore it gives extra years of dependable underground protection.

GET THIS L-M HANDBOOK

Pocket size; most complete, useful handbook of its kind. Covers selection of routes; positions of duct and cable; how to lay conduit; grades, curves, manholes, concrete; cable sizes, lubricants, bending radius, fireproofing. If you do not have a copy, ask the L-M Field Engineer, or write Line Material Company, Milwaukee 1, Wisconsin.



Harrington coupling

Split bushing

Solid bushing

Rough fit coupling

Standard 45 and 90-degree bends, for 18″, 24″, and 36″ radius, for all sizes L-M Conduit. Standard 45 and 90-degree elbows—radius from 8½″ to 24″ depending on conduit size. "S" bends with 20″ offset and 36″ radius are standard in all sizes.

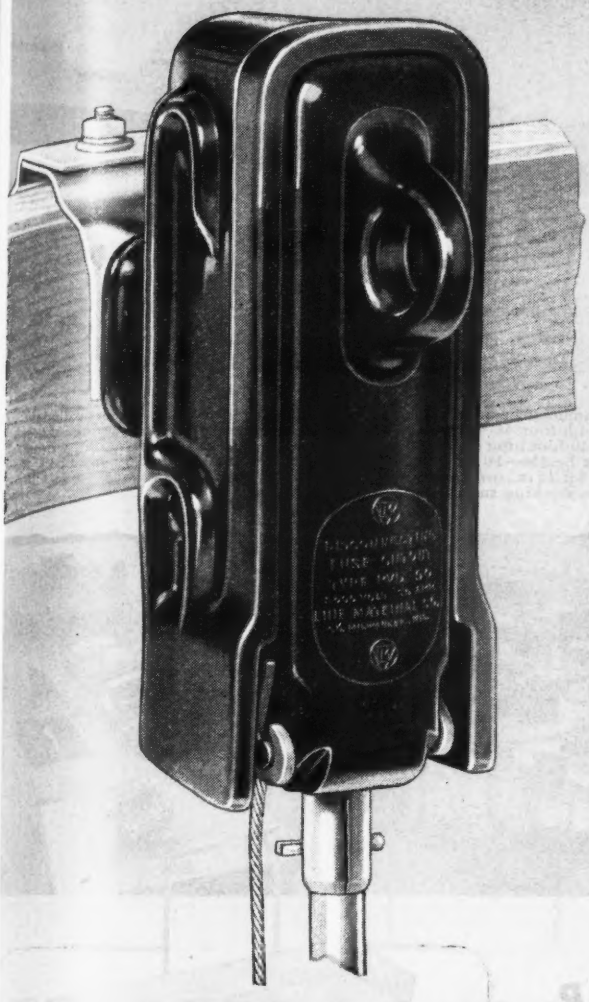
L-M Fibre Conduit is available in 5 and 8-foot lengths, from 1½″ to 5″ sizes, with choice of Harrington or Socket joints and a wide variety of couplings, bends, elbows, and fittings.

Here are a few of the many fittings available for L-M Fibre Conduit. For complete information, ask the L-M Field Engineer or call or write the nearest L-M branch office or Line Material Company, Milwaukee 1, Wis.

LM

LINE MATERIAL
FIBRE CONDUIT & FITTINGS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers · Fuse Cutouts and Fuse Links · Lightning Arresters · Oil Switches · Pole Line Hardware · Line Construction Specialties · Underground Equipment · Fibre Conduit · Street Lighting Equipment



L-M "PVD" FUSE CUTOUTS

restore service *faster because:*

...blown fuses quickly located
...quickly re-fused on the pole

L-M "PVD" Fuse Cutouts have the disconnecting and indicating features which assure instant action and faster restoration of service. The indicating feature, which can be seen from the ground, from any angle, makes it easy for the lineman to locate the blown fuse. The design of the "PVD" assures fast, safe, easy re-fusing right on the pole. Action is fast, positive in any weather. The door is always closed, the cutout is always protected. Get details on the many features that make "PVD" Fuse Cutouts outstanding.

Learn why so many distribution superintendents prefer and specify "PVD's". Call the nearest L-M office for a Field Engineer, or write Line Material Company, Milwaukee 1, Wisconsin.

FOUR SIZES

PVD-56: 5000 V., 50 A.
PVD-76: 7500/12500 V. Gr. Y., 50 A.
PVD-515: 5000 V., 100 A.
PVD-715: 7500/12500 V. Gr. Y., 100 A.

Fast, safe, on-the-pole re-fusing

In one minute...

Bakelite door swings open 180°, then unhooks, easily. Blown link is quickly removed and new link is inserted, cap is tightened, and new link is fastened around link flip-out device in one minute or less, even with gloved hands, and without tools.

in 6 seconds...

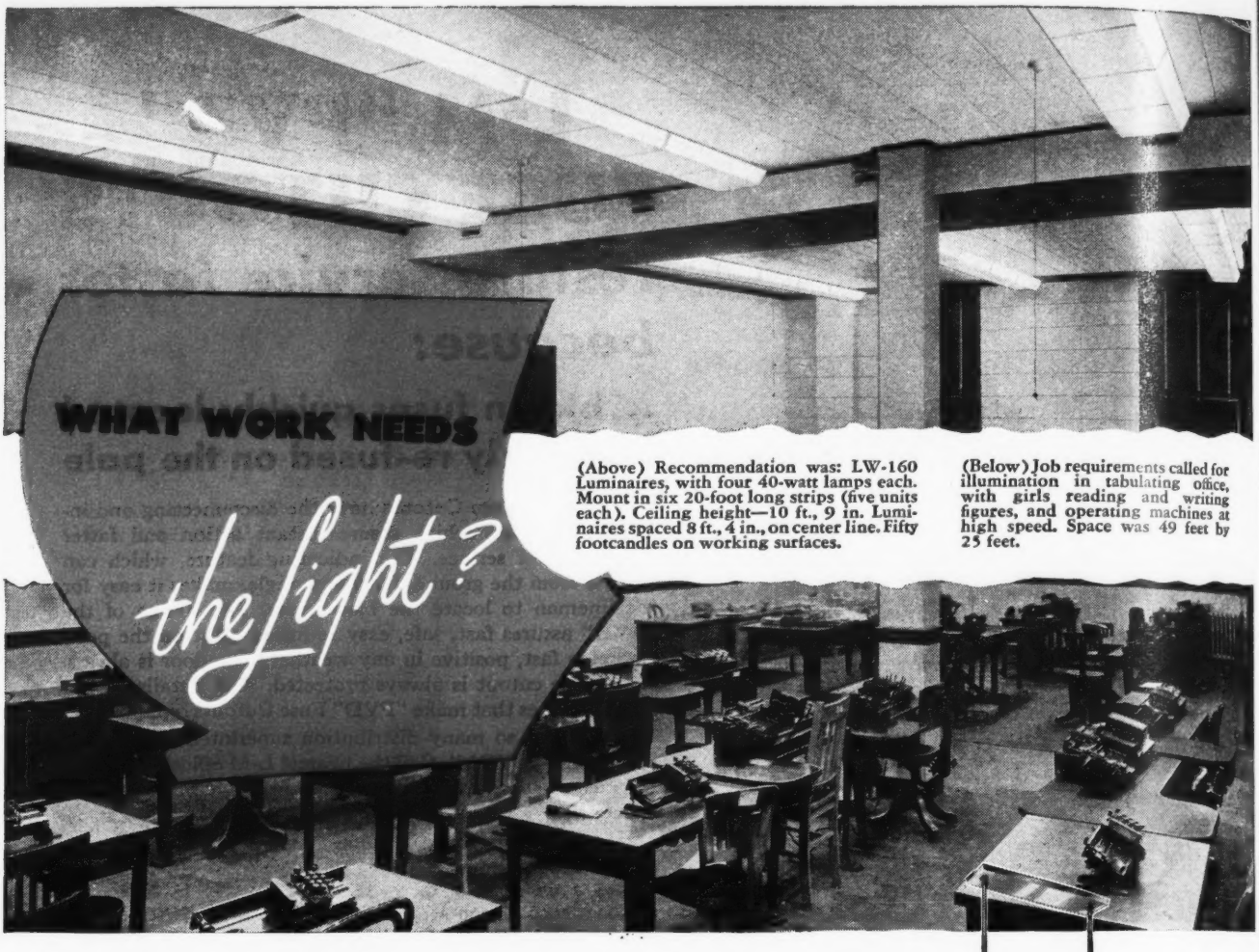
It is a matter of seconds for the lineman to open, unhook, and remove the bakelite door, and slam on a new spare fused "PVD" door. Bakelite doors are interchangeable, and the lineman who carries a spare fused "PVD" door can re-fuse a "PVD" Cutout in six seconds or less.

Ask the L-M Field Engineer

L-M Field Engineers know distribution problems, offer experienced, practical help. Get the counsel of this capable man—he knows many short cuts in pole line construction and maintenance that may help cut your time and costs.

LINE MATERIAL
FUSE CUTOUTS & FUSE LINKS

L-M DISTRIBUTION EQUIPMENT INCLUDES: Distribution Transformers · Fuse Cutouts and Fuse Links · Lightning Arresters · Oil Switches · Pole Line Hardware · Line Construction Specialties · Underground Equipment · Fibre Conduit · Street Lighting Equipment



(Above) Recommendation was: LW-160 Luminaires, with four 40-watt lamps each. Mount in six 20-foot long strips (five units each). Ceiling height—10 ft., 9 in. Luminaires spaced 8 ft., 4 in., on center line. Fifty footcandles on working surfaces.

(Below) Job requirements called for illumination in tabulating office, with girls reading and writing figures, and operating machines at high speed. Space was 49 feet by 25 feet.

TELL THE WESTINGHOUSE ENGINEER

Whether it's an executive office . . . a stenography department . . . or machine tabulating—give this fact, plus the ceiling height, desk spacing and other job requirements to the Westinghouse lighting engineer.

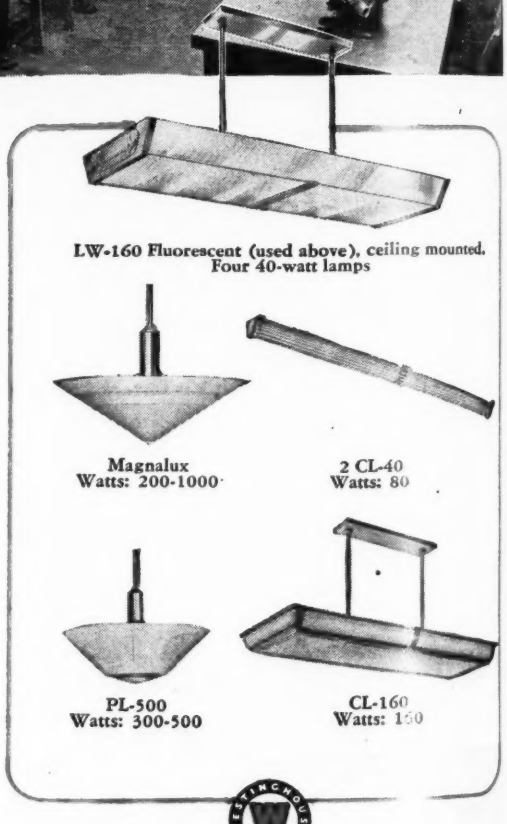
In other words, show him the bottom half of the picture, as above. Then depend on him to fill in the top half—to meet those requirements completely and economically.

This engineer is the man best fitted to recommend the proper combination of intensities, diffusions, lamp sizes, spreads, colors and so on. This is true because he is the only man who has available:

1. *A broad line of lighting equipment.*
2. *Wide experience in commercial lighting applications.*
3. *Periodical laboratory schooling.*
4. *Data on latest development work.*

With all this at hand, the Westinghouse lighting engineer is pre-eminent in his field. You can reach one of these men through your nearest Westinghouse Distributor. Give him the job requirements—get his lighting analysis and recommendations. Westinghouse Electric & Manufacturing Co., Edgewater Park, Cleveland 1, Ohio.

J-04032



LW-160 Fluorescent (used above), ceiling mounted. Four 40-watt lamps

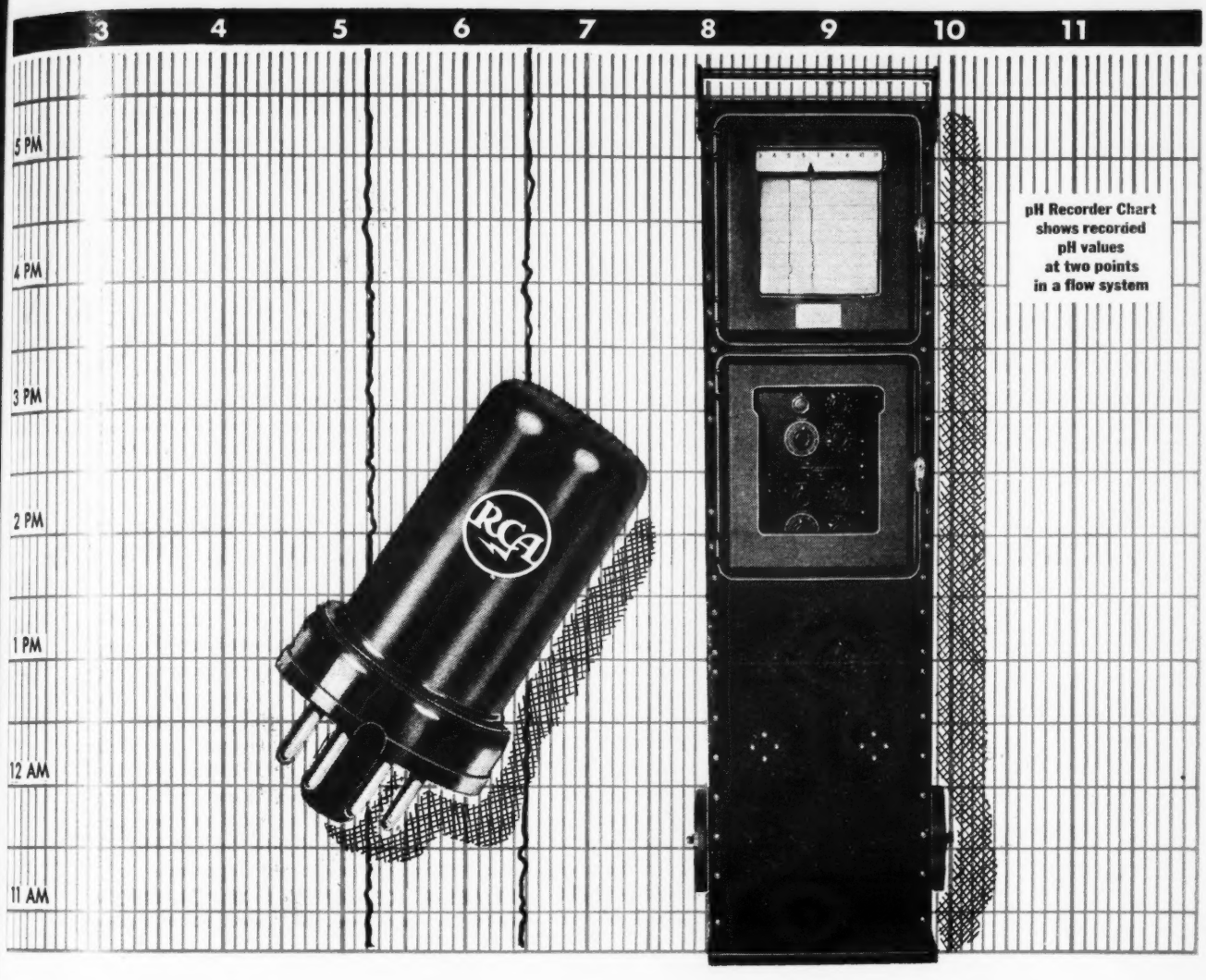
Magnalux
Watts: 200-1000

2 CL-40
Watts: 80

PL-500
Watts: 300-500

CL-160
Watts: 150

Westinghouse Lighting



pH Recorder Chart shows recorded pH values at two points in a flow system

How RCA Tubes Help Test Chemical Solutions

Cambridge Instrument Company's Electronic pH Recorder Warns of Adjustments Needed to Prevent Corrosion and Waste.

CONTROL of acidity or alkalinity in many industrial processes should be immediate, and must be held within specified limits throughout the process in order to prevent corrosion and obtain uniform products.

Ordinarily, samples of the solution are taken at various points in a flow system, analyzed in the laboratory, and the process is adjusted accordingly. But this takes time and offers only a limited accuracy of control . . . with the possibility of human error.

Exit test tubes . . . enter RCA electron tubes!

The electronic pH Recorder developed by the Cambridge Instrument Company, utilizing RCA Tubes, determines and records graphically at a central location the pH value of a solution at several different points. (The pH value of a solution is a number indicating hydrogen ion concentration and, therefore, the degree of acidity or alkalinity of the solution.)

How It Works: In the electronic pH recording system, a glass electrode is immersed in the solution at each point to be measured. The ion concentration, or pH, of the solution produces an electrical potential between the electrode and the solution. Measurement of this minute potential . . . made possible by RCA amplifier tubes . . . indicates the pH of the solution. As many test electrodes can be used as are needed to give accurate, continuous control of the pH of the entire flow system. The electrodes are connected electrically to the central control point, which may be located anywhere.

Applications: The electronic pH recorder makes possible accurate control of the acidity of boiler water feed, corrosion in oil refineries, carbonation in sugar refineries, fermentation in breweries and distilleries, and at numerous stages in the manufacture of paper and textiles.

Listen to "THE MUSIC AMERICA LOVES BEST," Sundays, 4:30 P. M., E. W. T., NBC Network

THE FOUNTAIN-HEAD OF MODERN TUBE DEVELOPMENT IS RCA

For Further Information on the electronic pH recorder, write to the Cambridge Instrument Co., Grand Central Terminal, New York City. If you have some *other* problem involving the use of electron tubes, RCA tube application engineers will be glad to help you or put you in touch with a manufacturer who can.

For a copy of the free 32-page booklet, "Electrons in Action at RCA," write to RADIO CORPORATION OF AMERICA, Commercial Engineering Section, Dept. 62-51W, Harrison, N. J.

RCA

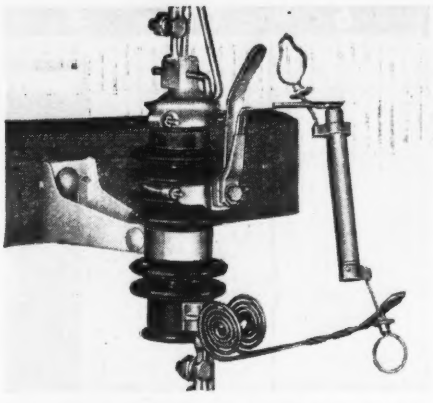
BUY WAR BONDS

42-6336-51

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION · CAMDEN, N. J.

FUSE LINKS—individually wrapped, then packaged again in packets of five, arrive at the pole just the way they leave the Kearney factory.



LIGHTNING STROKES dissipated through low resistance path to ground. Power follow-up interrupted within the horn fibre fuse tubes.

CLAMPS. There is a Kearney Con-nec-tap clamp for the most unusual load or construction problem. Made in many types for all wire sizes

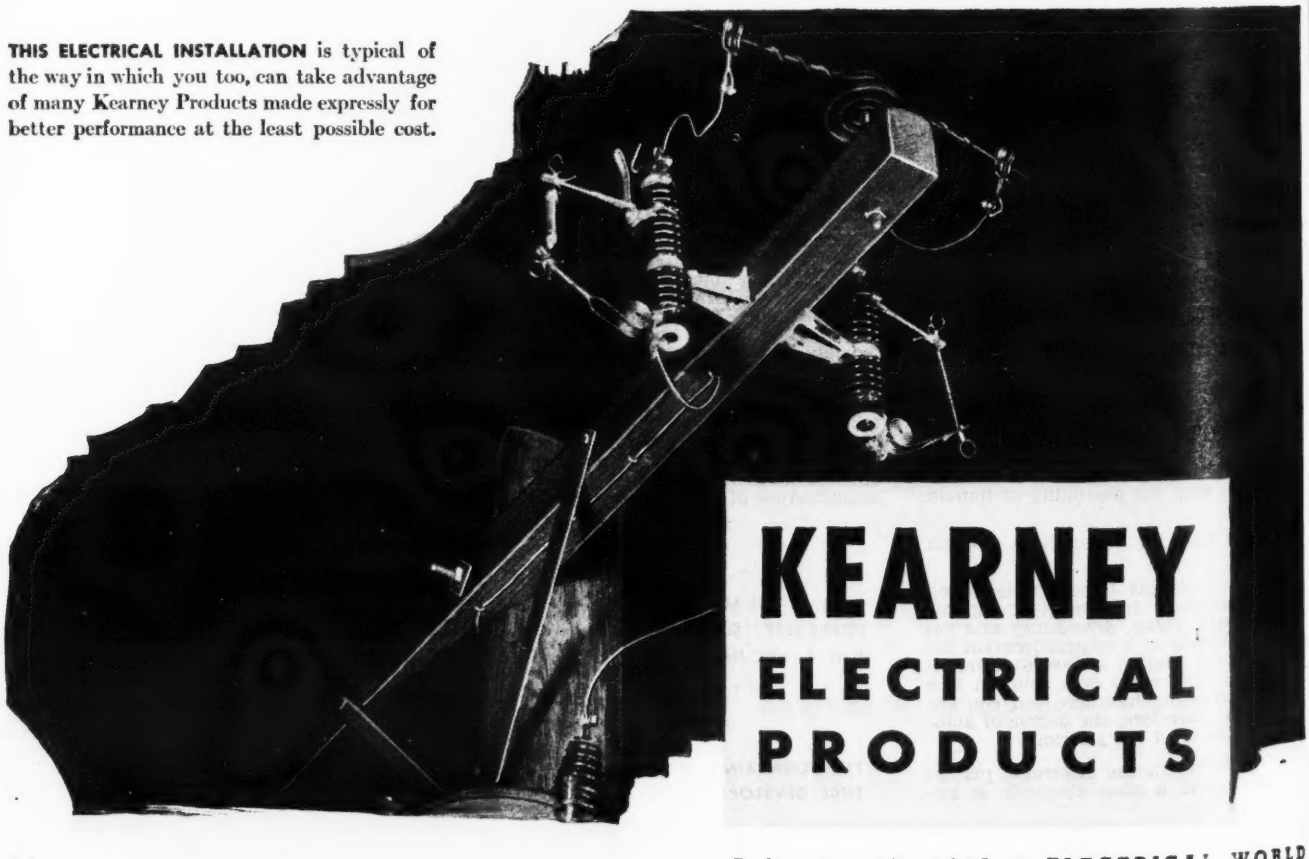
RELATED CONSTRUCTION UNITS

One certain way of eliminating maintenance on any mechanical or electrical device is to replace worn or used parts after each operation. Sounds impractical but have you looked at the Kearney Trip-O-Link Fuse Switch? The porcelain in the insulator being an inert material is impervious to wear and tear. The hanger and fittings attachments made of carefully chosen materials, are in much the same category. Damage and wear caused by lightning, short-circuits and excessive loads are nearly always confined to the cartridge of a fuse switch. With the Trip-O-Link the ideal is closely approached because each re-fusing brings with it a fresh, full-dimensioned fibre-lined cartridge as an integral part of the fuse link. At the same time clean contacts are made because the bright new cable of the fuse links goes directly into the permanent switch contacts. In these days of revolutionary designs, take time out to investigate the Trip-O-Link. Please address your letter to Department "H,"

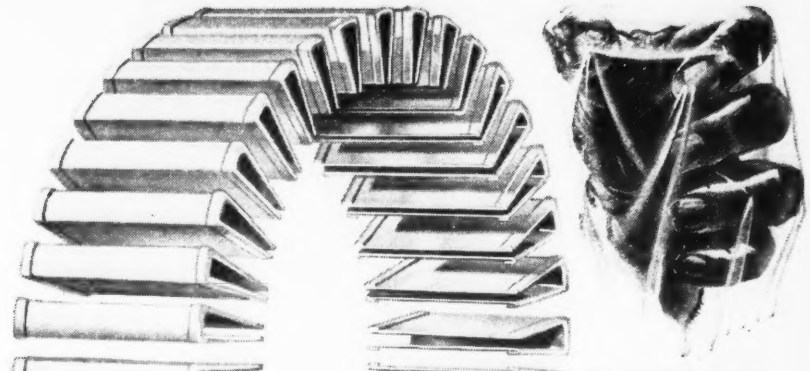
JAMES R. KEARNEY CORPORATION,
4236 Clayton Ave., St. Louis 10, Missouri

POSITIVE — LIGHT-WEIGHT — SAFE — LOW-COST

THIS ELECTRICAL INSTALLATION is typical of the way in which you too, can take advantage of many Kearney Products made expressly for better performance at the least possible cost.



KEARNEY ELECTRICAL PRODUCTS



BLOCKS THE BLACK HAND OF CORROSION

Lumarith* C.A.

GIVES FREE-AIR PROTECTION TO ELECTRICAL EQUIPMENT

ORDINARY INSULATION paper—laminated both sides with Lumarith Transparent Foil—will increase the life of your electrical equipment. Lumarith Foil is a cellulose acetate base plastic with dielectric strength that remains high, even when subject to excessive humidity and temperature. Its smooth, shiny surface eases winding operations in small or hard-to-reach spaces. Lumarith is tough and flexible. As in slot insulation illustrated above, it can be folded or creased without cracking—without losing dielectric strength.

Electrical equipment insulated with Lumarith is free of corrosion hazards that threaten with other types of insulation. Lumarith is resistant to electrolytic action. It does not combine with moisture and current to give corrosion a breeding ground.

Write for names of laminators using Lumarith Foil, and ask for Electrical Booklet about Lumarith plastics in the electrical field. Celanese Plastics Corporation, *a division of Celanese Corporation of America*, 180 Madison Avenue, New York 16, N. Y.

A-78 MAT FINISH PREVENTS WIRE SLIPPAGE

. . . gives more visibility to foil . . . increases elongation . . . does not require talc or other lubricants.

*Reg. U.S. Pat. Off.

Celanese Yarns and Fabrics offer the same qualities of high dielectric strength and corrosion resistance as Lumarith Plastics. For data, address Celanese Corporation of America, 180 Madison Ave., New York 16, N.Y.

A Celanese Plastic*

Serving America's Industries with Standard

TRADE MARK

. . . . . When considering Standard Transformers you naturally want to know where they are now being used, how long they have been in service, what users think of them. We will be glad to have you check these facts with the users—to "ask the man who owns one."

Pictured on the opposite page are a few representative installations of Standard Transformers in industrial and utility service. Naturally we can't begin to show our range of sizes and types in such limited space. But the nearest Standard representative will be glad to give you the complete picture.

Your investigation will quickly convince you that "Standard Transformers" is a good specification always!

THE STANDARD TRANSFORMER COMPANY

WARREN, OHIO • REPRESENTATIVES IN PRINCIPAL CITIES

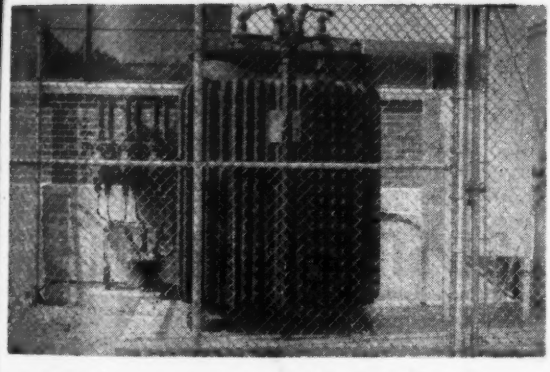
Makers of Transformers for: Distribution..... Power... Meteri...

OVER A QUARTER CENTURY OF EXPERIENCE.....

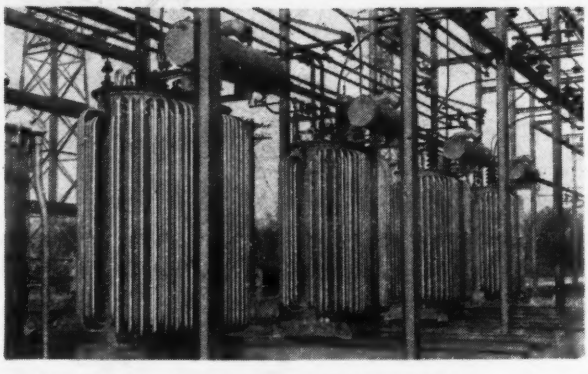
This 750 KVA, three phase STANDARD transformer is placed at a load center in a Carnegie Illinois Steel Corporation mill.

vital in war and peace

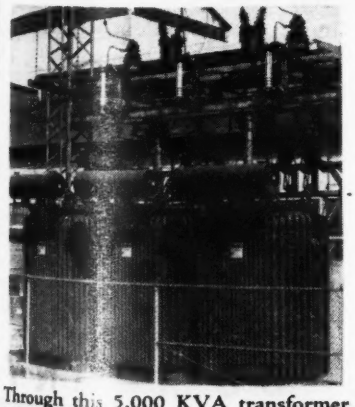
RANSFORMERS



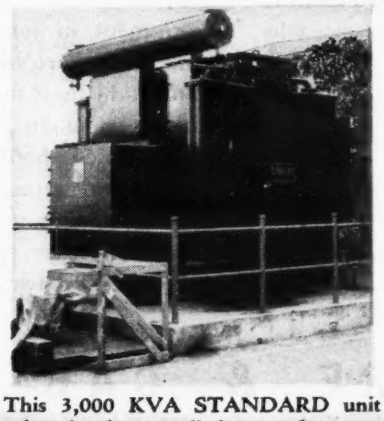
A Hygrade-Sylvania lamp plant in Massachusetts has received years of dependable service from this 450 KVA installation.



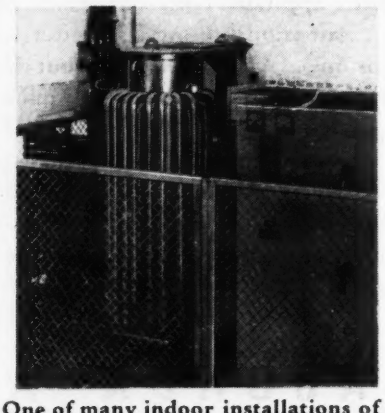
STANDARD power transformers give faithful performance in a utility substation in Memphis.



Through this 5,000 KVA transformer bank has gone millions of KWH of power to help produce vital war implements manufactured by Graham-Paige.



This 3,000 KVA STANDARD unit substation has supplied power for many years to ships at dock in a West Coast Navy Yard.



One of many indoor installations of STANDARD ASKAREL filled transformers. This one supplies some of the power needed in the manufacture of landing barges.

reet Lig ng..... Testing..... Dry and Liquid Filled Types

SPECIALIZING IN DESIGNS TO MEET USERS SPECIFICATIONS

Because of the basic importance of adequate wiring to the entire electrical industry, Anaconda is presenting messages like this in a wide list of national publications.

IT'S YOUR POSTWAR ELECTRICAL HOME

—See that it works!

THINK of your electrified home to come . . . big and little appliances of all kinds . . . advanced heating . . . air-conditioning . . . better lighting . . . television . . . All fine servants—but they will be handicapped if you give them insufficient electrical capacity.

So often electrical wiring plans are based on *past* electrical experience—a poor guide to the needs of peak loads to come. It's far safer to plan *reserve* capacity in line with the huge future increase in electrical usage. You'll save yourself plenty of grief later in breakdowns and expensive alterations.

Manufacturers! Apply this in terms of industrial equipment in *your* business. The problem's the same. Make sure you have ample electrical capacity to meet the huge future increases in electrical usage sure to come. In plants too, planned wiring will cost a lot less than unplanned wiring.

Before structures get out of the planning stage, it will pay to consult electrical contractor, utility power engineer, plant power engineer. They'll agree that it's always wiser to *Wire Ahead!*

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities

ANACONDA

It's Always Wiser to WIRE AHEAD

BAKELITE

TRADE-MARK

TOWER OF *Dielectric* STRENGTH 4" HIGH

JUST 4 INCHES HIGH—this housing for a Millen coil! But it gives peak performance in high-frequency circuits where low-loss insulation is a topmost requirement. It's made of BAKELITE polystyrene, noted for its exceptional dielectric qualities, dimensional stability, low water absorption, and remarkable resistance to most chemicals.

Designers and manufacturers of electrical and electronic equipment will be interested in the many outstanding properties of BAKELITE polystyrene. It has a high index of refraction. Its specific gravity is low—1.05. It is produced in various forms that are adaptable to several methods of fabrication. Bakelite Corporation supplies BAKELITE polystyrene plastics in the form of molding materials and insulating films. Fabricators supply BAKELITE polystyrene plastics in such forms as rigid sheets, tubes, and rods; flexible film that can be punched and stamped; filaments in continuous rolls; and electrical insulating coatings.

Our Engineering Staff and Development Laboratories will be glad to work with you in applying BAKELITE polystyrene plastics to essential applications. Write Department 47 for names of fabricators.

TRADE MARK

BAKELITE CORPORATION

Unit of Union Carbide and Carbon Corporation

30 EAST 42ND STREET, NEW YORK 17, N.Y.

UCC

Polystyrene Plastics

"Not a Single Main Line Fuse Failure in Three Years—*Since We Switched to BUSS Super-Lag*"

Says **MR. C. E. TUFTE,** President Elkhart-Moraine Sand & Gravel Co. • Elkhart Lake, Wisconsin

"We had been having too much trouble on our main circuit, protected by 600 ampere, 440 volt renewable fuses. On an average of once a week this circuit was shut down because fuses went out due to temporary overloads. An extra heavy load in crushers, or the simultaneous starting of several motors would cause a temporary overload and a fuse would blow. This unnecessary blowing of fuses produced a very aggravating situation—left workers idle—shut down production—and lost money for us.

"Then, three years ago, we switched to Buss Super-Lag fuses—*and we haven't had a single failure since.* What a relief that has been. And today's operating conditions are tougher than they were three years ago, because our production is greater, with less time for maintenance and repairs."

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES
in the design of the FUSE-CASE help make it possible

and

The SUPER-LAG
development in the FUSE-LINK completes the job.

BUSS

You, too, can get relief from production breakdowns due to fuse failures. The solution to your problem is just as easy as it was for Mr. C. E. Tufte at Elkhart-Moraine Sand & Gravel Co. BUSS Super-Lag fuses provide the extra-time lag to protect against harmless surges, yet give complete and adequate protection.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Here Is Why BUSS Fuses Greatly Reduce or Entirely Prevent Needless Blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

How to solve the "shutdown" problem

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo.
Division McGraw Electric Company

Super-Lag FUSES SOLD THROUGH WHOLESALERS

Intelin
THE Right Cable
FOR THE JOB
NOT BY ACCIDENT . . . BUT BY DESIGN
Federal Telephone and Radio Corporation
TABLE I—SINGLE BRAID TYPES
TABLE II—DOUBLE BRAID TYPES
TABLE III—ARMORED TYPES
TABLE IV—AIR SPACED LOW CAPACITANCE TYPES
TABLE V—DUAL CONDUCTOR (TWINAX) TYPES
ANTENNAE LEAD IN WIRE
TABLE VI—DUAL COAXIAL TYPES

To assist the equipment designer Federal offers comprehensive data on high frequency cables.

This technical information sheet provides the design-engineer with pertinent electrical and physical characteristics...including impedance, capacitance, attenuation, diameter, materials, and weight . . . for Federal's wide variety of high-frequency cables.

Single and double braid, armored, dual conductor and dual coaxial, air-spaced, low capacitance lines, and antenna lead-in wire . . . there's a right type for your job, backed by the built-in superiority that's a tradition with Federal.

Special developments in flexible low-loss cables by Federal have resulted in superior cables for all types of transmission. For a better job, see Federal first.

Write for your cable information sheet today.

FEDERAL TELEPHONE & RADIO FTR

Federal Telephone and Radio Corporation

Newark 1, N.J.

POSTWAR TRENDS in MACHINE TOOL DESIGN

Broaching machine, made by National Broach & Machine Co., with Allen-Bradley built-in control panels and limit switches.

1st – STREAMLINED CONSTRUCTION

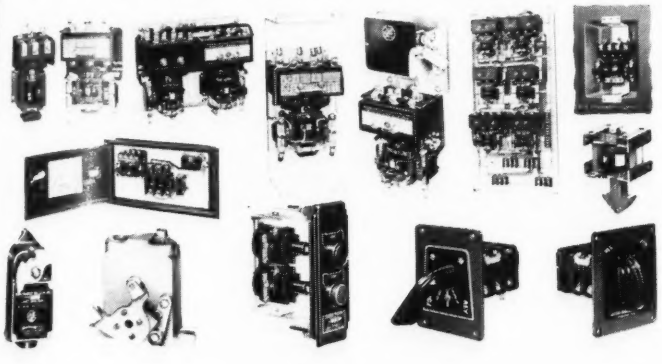
2nd – BUILT-IN MOTOR CONTROLS

Machines are being streamlined. Designers of postwar equipment are giving close attention to appearance. Utility, alone, is not enough!

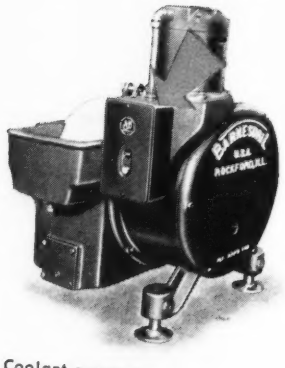
That's why so many postwar machines will be equipped with "built-in" controls. Starters, contactors, relays, and disconnect switches... arranged on panels to provide the correct sequence operation... will be mounted within machine bases or columns.

Allen-Bradley standard units are ideal for built-in control applications. They are compact, long lived, and trouble-free. The silver alloy contacts require no service attention. See Sweet's 1944 Product Design File (Section 3B1) for 24-page Allen-Bradley catalog or send for bulletins.

Allen-Bradley Standard Units for Built-in Motor Controls



Bakewell radial drilling and tapping machine, now made by Warner-Swasey, equipped with Allen-Bradley built-in control panels.



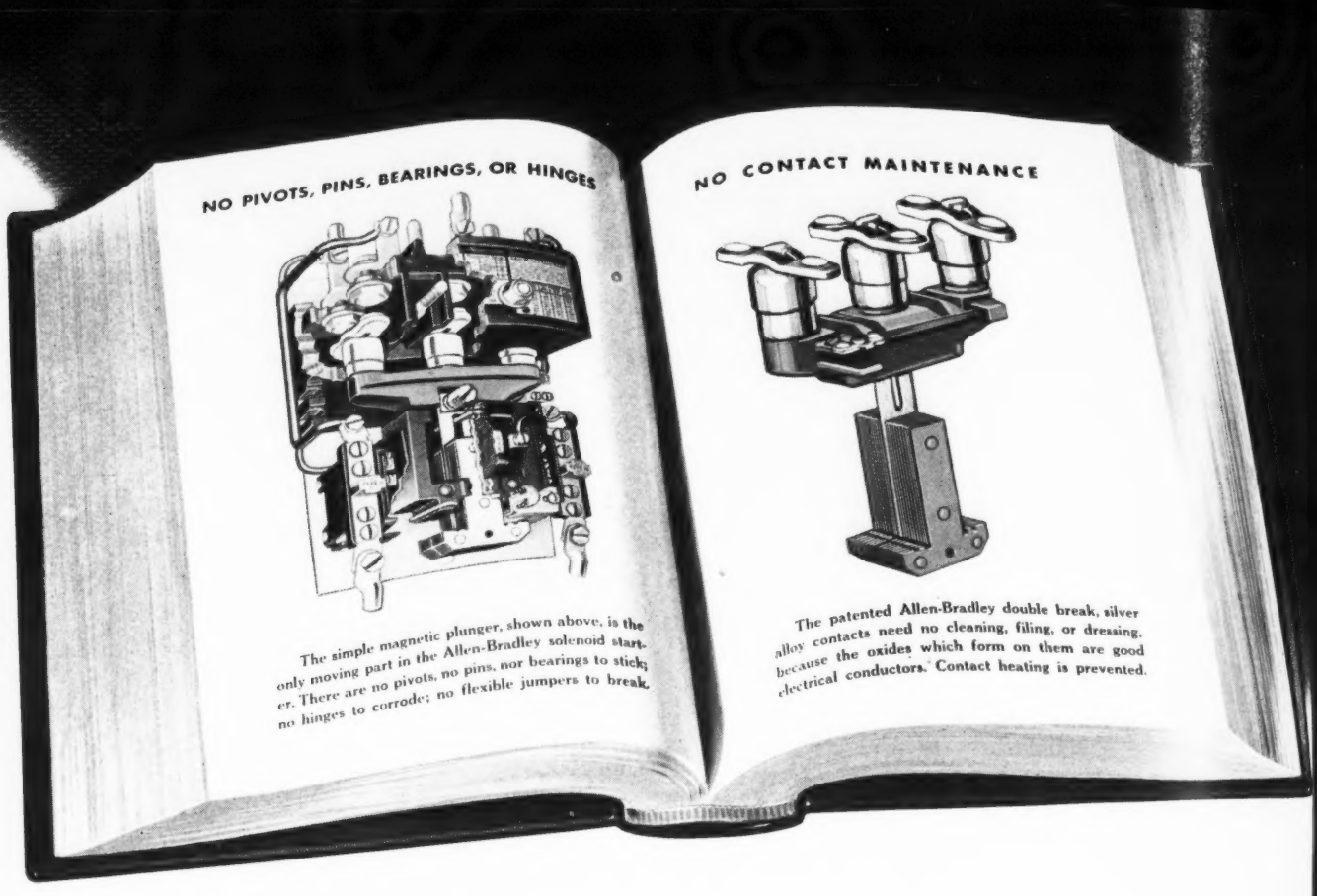
Coolant separator, designed by Barnes Drill Co., with built-in Allen-Bradley manual across-the-line starter.

A-B

ALLEN-BRADLEY

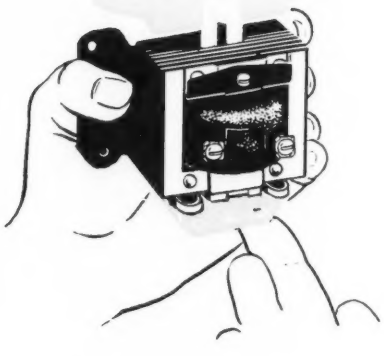
SOLENOID MOTOR CONTROL

QUALITY


NO PIVOTS, PINS, BEARINGS, OR HINGES
The simple magnetic plunger, shown above, is the only moving part in the Allen-Bradley solenoid starter. There are no pivots, no pins, nor bearings to stick; no hinges to corrode; no flexible jumpers to break.
NO CONTACT MAINTENANCE
The patented Allen-Bradley double break, silver alloy contacts need no cleaning, filing, or dressing, because the oxides which form on them are good electrical conductors. Contact heating is prevented.

The Amazing Success Story of Allen-Bradley Solenoid Starters can be told in 4 words:

"Only one moving part"



The double break, movable contacts of the A-B solenoid starter are mounted on an insulated cross-bar which is attached to the simple magnetic plunger.

Every engineer knows... and every maintenance man agrees... that the greatest simplicity in design is the best assurance of trouble-free starter operation. Less parts mean less trouble.

Therefore, when a motor starting switch... like the Allen-Bradley solenoid starter... has *only one moving part*, it is not only the SIMPLEST but also the most trouble-free starter on the market.

The widespread preference of machinery builders for Allen-Bradley solenoid controls accounts for the dominant position of the Allen-Bradley line in recent market surveys. Machinery builders understand the value of a simple design, especially in severe service... so they specify Allen-Bradley solenoid control.

Allen-Bradley Company, 1316 S. Second St., Milwaukee 4, Wis.

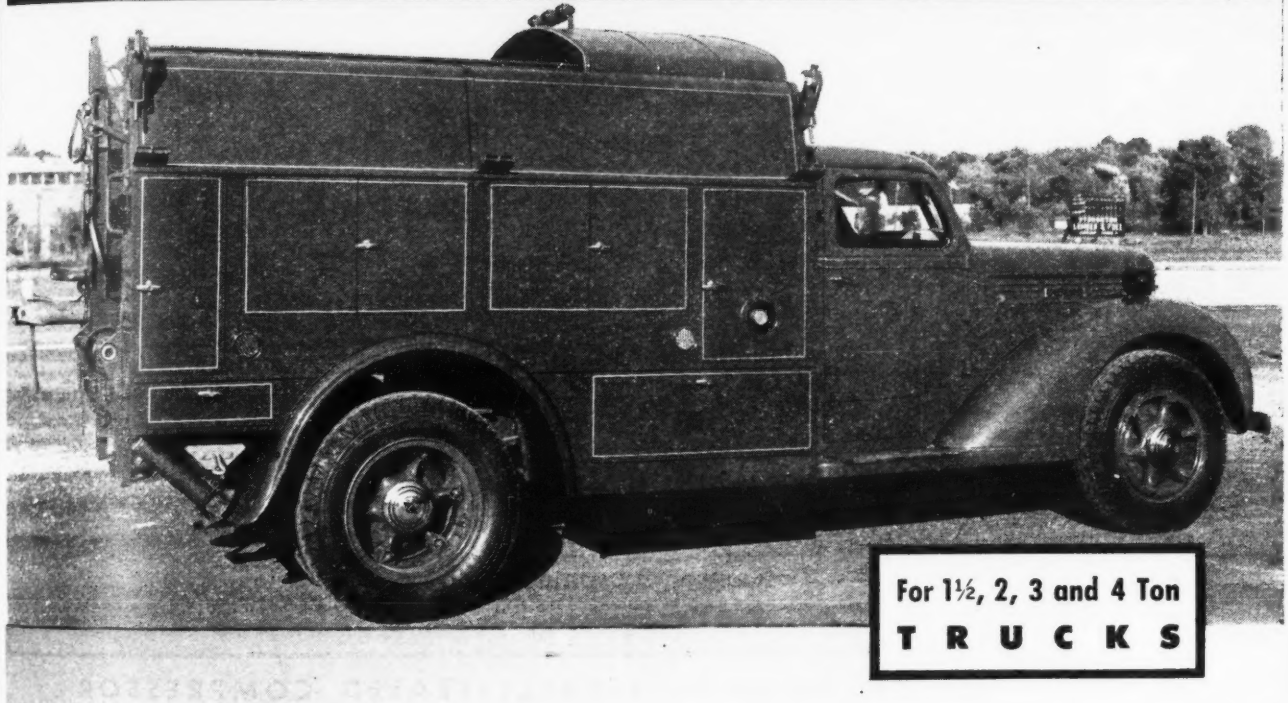
A-B

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY

A *Leader* IN THE PUBLIC UTILITY FIELD···

HIGHWAY

LINE CONSTRUCTION AND MAINTENANCE BODIES AND ASSOCIATED EQUIPMENT



For 1½, 2, 3 and 4 Ton
T R U C K S

Highway equipped line construction and maintenance trucks provide the utmost in efficient and durable service.

Highway bodies, winches, power take-offs, pole derricks, towing hooks, power reels and other kindred items that properly complete a line construction and maintenance truck are all designed to associate and operate efficiently with each other.

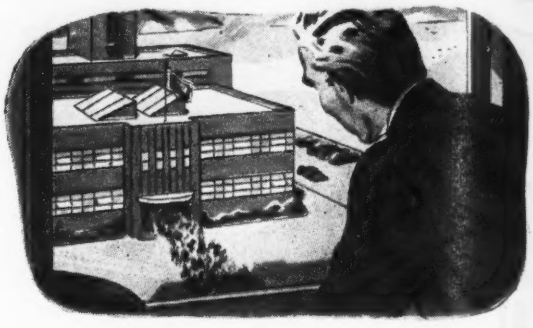
The design and construction of each item, from the winch line hook to the body proper, reflect the technical knowledge of many utility equipment engineers and the experience of operating crews in every section of the country.

The selection of only the best of materials for the purpose, combined with skilled workmanship gained through years of manufacturing practice, assures light weight, strength and high factors of safety—features that are characteristic of Highway public utility equipment.

HIGHWAY TRAILER COMPANY
MANUFACTURERS OF
TRUCK TRAILERS AND BODIES • EARTH BORING MACHINES • WINCHES • OTHER PUBLIC UTILITY EQUIPMENT
General Offices
EDGERTON, WIS., U. S. A.

So Smith joined the parade

1 Smith hired many well-trained workers,
But they never seemed to stay.
No one could have called them shirkers —
Jobs were fine, so was the pay.



2 While at Johnson Brothers' factory
Jobs were hard to get — and prized.
Workers found things satisfactory;
Johnsons' had been modernized.

3 Did Smith take a long shellacking
'Ere he copied Brothers J?
No, he added what was lacking
And his air's *correct* today.

Air Conditioning will be a postwar essential to almost every conceivable business. Executives everywhere — your commercial and industrial consumers — are hearing about *correct* air conditioning through advertisements like this.

They're learning to depend upon Westinghouse and its years of pioneering research and engineering experience — for *correct air conditioning* . . . the scientifically-engineered blending of correct temperature, humidity, circulation, ventilation and air cleanliness.

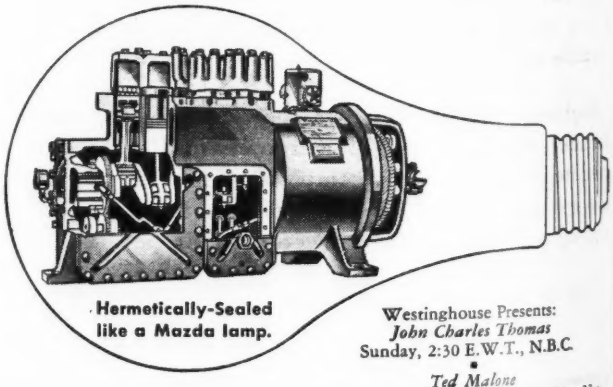
Your commercial men will find the Westinghouse booklet "How to Plan Your Postwar Air Conditioning Today," a valuable aid in showing consumers how to get what they need for their complete satisfaction. We'll be glad to supply it in quantity. Phone your nearest Westinghouse office or write Westinghouse, 150 Pacific Avenue, Jersey City 4, N. J.

THE SERVICE-PROVED HERMETICALLY-SEALED COMPRESSOR

These Westinghouse economy-satisfaction advantages have been proved by years of service in thousands of installations:—

No Shaft Seals. During wartime refrigerant shortages, few Westinghouse systems were ever "down." Why? Because seal leaks, cause of 90% of all system failures, are eliminated.

Few Parts to Wear . . . Direct-Drive Efficiency . . . Space-Saving Refrigerant-Cooled Motor.



Hermetically-Sealed like a Mazda lamp.

Westinghouse Presents:
John Charles Thomas
Sunday, 2:30 E.W.T., N.B.C.

•

Ted Malone
Mon. Tues. Wed. 8:00 E.W.T., Blue Net.

Westinghouse CORRECT Air Conditioning

PLANTS IN 25 CITIES . . OFFICES EVERYWHERE

AN OPEN LETTER
to Users of Electrical Insulation:

Throughout our 56 years we have welcomed every opportunity to meet the progressively increasing tempo of electrical insulation requirements and whenever there was no product available to meet a new condition our research department was put to the task of developing and producing the product to meet the new need.

TRIPLE-STRENGTH FIBERGLAS TUBING IS THE LATEST OF SUCH DEVELOPMENTS.

Triple-Strength combines in one tubing the most significant values and properties required of electrical insulation, today.

No longer is it necessary to specify one brand of tubing for dielectric up to 3500 volts, another for non-fraying ends, another for slow burning, another for solvent or moisture or humidity resistance or for extreme flexibility—*all of these qualities are built-into Triple Strength, the optimum in Tubing and Sleeving for electrical insulation.*

Triple-Strength will withstand more abuse and rough handling than any known insulating sleeving or tubing, without losing any of its qualities.

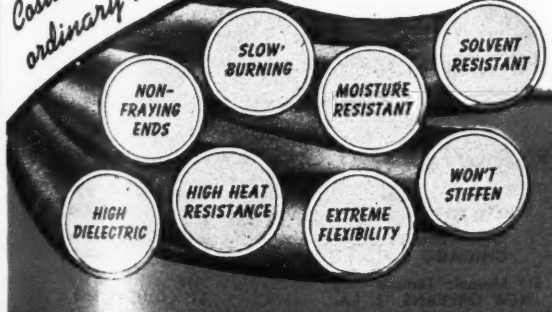
Triple-Strength can be used on the leads of transformers which are to be potted in high melting point compounds and in assemblies which after they are completed are dipped and baked for six or more hours at 250° F., to cure the varnish coating of the assembly.

SPECIFY TRIPLE-STRENGTH AND OBTAIN THE OPTIMUM IN TUBING AND SLEEVING FOR ELECTRICAL INSULATION.

W. B. Stevens

President, Mitchell-Rand
Insulation Company

M-R
TRIPLE-STRENGTH
Fiberglas TUBING
Costs no more than ordinary tubings!



FREE FOR YOUR ASKING

A Sample Card of Varnished Tubings, samples to fit sizes from B&S wire #20 (.032") to #0 (.325"). a Wall Chart with quick easy to read reference tables of electrical symbols, capacity of conductors, dielectric averages of insulating materials, mathematical tables, tap drill sizes, standards of varnished tubing sizes . . . Wax and Compound Guide Book and the M-R Book of Electrical Insulations . . . all are Free for your asking . . . *write for them on your letterhead.*

MITCHELL-RAND *for* **56 YEARS THE ELECTRICAL INSULATION HEADQUARTERS**

MITCHELL-RAND INSULATION COMPANY, INC.

51 MURRAY STREET COrtlandt 7-9264 **NEW YORK 7, N. Y.** EST. 1889

Fiberglas Varnished Tape and Cloth Insulating Papers and Twines Cable Fillers and Pothead Compounds Friction Tapes and Splice Transformer Compounds

A PARTIAL LIST OF M-R PRODUCTS
Fiberglas Braided Sleeving
Cotton Tapes, Webbings and Sleevings
Impregnated Varnish Tubing
Insulating Varnishes of all types

Fiberglas Saturated Sleeving and Varnished Tubing
Asbestos Sleeving and Tape
Extruded Plastic Tubing
Varnished Cambric Cloth and Tape
Mica Plate, Tape, Paper, Cloth and Tubing

How T&B Grounding WEDGES

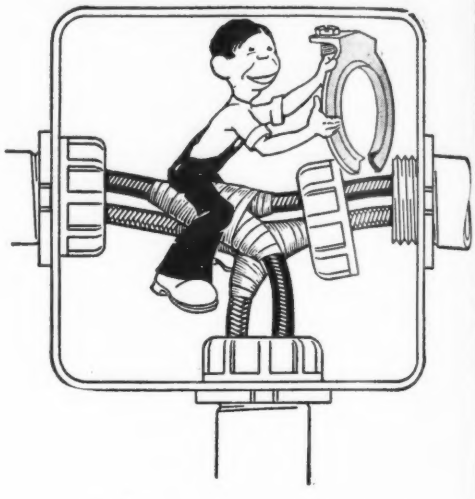
Save on Installation Work and Material

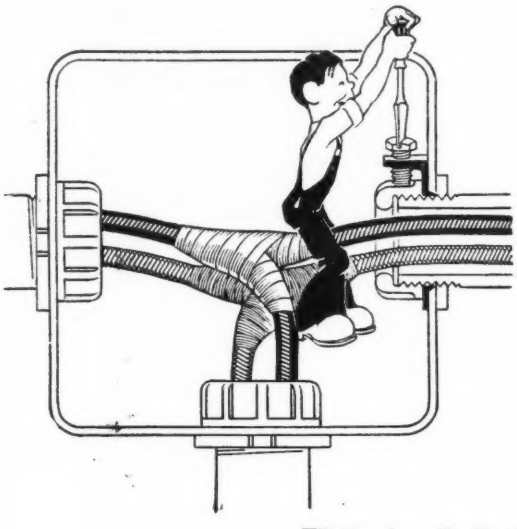
On *old* work this Patented, absolutely simple T&B Grounding device makes it wholly unnecessary to untape wires, disconnect the wire connections, install conventional ground bushings and jumper wire, reconnect the wires and retape them.

Instead you simply loosen your standard conduit bushing, slip your T&B Grounding Wedge over the wires without disturbing them, and screw your bushing back in place.

To complete the job, you merely tighten up the Wedge with a screwdriver.

Follow the same simple procedure on all your *new* grounding jobs.





These T&B Grounding Wedges are Approved by the Underwriters Laboratories either with or without the use of jumper wire. They form a mechanically and electrically perfect bond between conduit and outlet box and provide one continuous metallic path to the ground, replacing jumper wires at boxes.

Made of bronze, the flange of the wedge is accurately machined to fit easily and snugly into the knockout. They come in thirteen sizes—from ½″ to 6″ and, like all other T&B products, are sold through the service organizations of T&B Distributors exclusively.

Write for Bulletin EW-7 which gives full information on these T&B Grounding Wedges as well as on the complete line of T&B Built-in Solderless Ground Fittings.

THE THOMAS & BETTS COMPANY HAS DISTRICT OFFICES* LOCATED AT:

415 LaForte Ave.
SYRACUSE, N.Y.

1645 Wazee St.
DENVER 2, COLO.

15 Park Place
NEW YORK 7, N. Y.

157 Federal St.
BOSTON 10, MASS.

542 Natoma St.
SAN FRANCISCO 3, CALIF.

103 N. Santa Fe Ave.
LOS ANGELES 12, CALIF.

15 N. Jefferson St.
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244 N. 10th St.
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423 Citizens & Southern Bldg.
ATLANTA 3, GA.

513 Masonic Temple Bldg.
NEW ORLEANS 12, LA.

110 South 9th St.
ST. LOUIS 2, MO.

301 Eyres Bldg., 2207 First Ave., S.
SEATTLE 4, WASH.

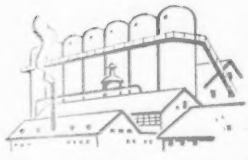
415 Brainard St.
DETROIT 1, MICH.

1900 Euclid Ave.
CLEVELAND 15, OHIO

*Additional district representatives in many other cities.

THE THOMAS & BETTS CO.
INCORPORATED
manufacturers of electrical fittings since 1899
ELIZABETH, N. J. NEW JERSEY
In Canada: Thomas & Betts Ltd. Montreal

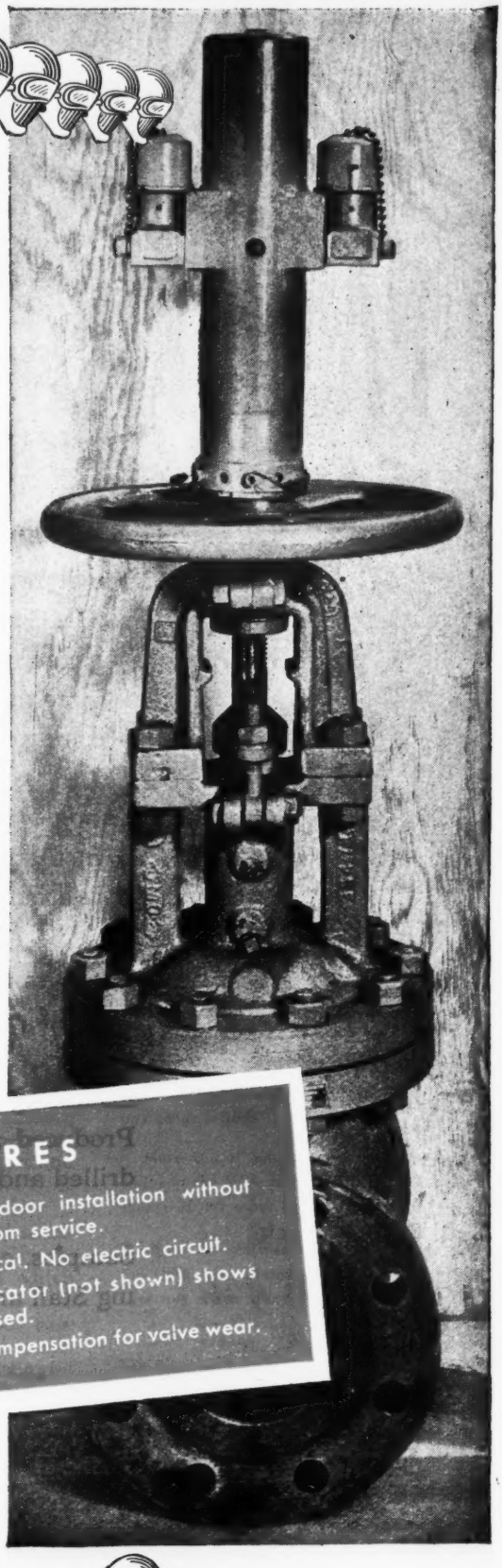
MECHANICAL GUARDIANS FOR CHEMICAL PIPE-LINES



In chemical industries, synthetic rubber plants, oil refineries... any plant, piping precious or potentially hazardous fluids... a mistake, whether unintentional or deliberate, in adjusting a chemical pipe-line valve can prove both dangerous and costly. But prevention of these human errors is easy and infallible with BENDIX-CORY* SAFETY INTERLOCKS... the locks that say "No!" to unauthorized handling of your valves.

The BENDIX-CORY SAFETY INTERLOCK illustrated gives absolute control over the opening and closing of the valve to which it is attached... and, by use of an interlock key, can also control the position of this valve in relation to any number of other valves. The unit is wholly mechanical, and fully adjustable to compensate for valve wear —one of a number of interlocks specially designed for valve protection.

As safety men of the Bendix "Invisible Crew," BENDIX-CORY SAFETY INTERLOCKS are dependable guardians for your pipe-lines. Write for full information.



CHECK THESE FEATURES

- Interlocks stem valves 2" to 8". Other interlocks for globe, lead and porcelain valves.
- Absolute control of valve opening and closing under all conditions.
- Positions valve in relation to other valves.
- Angle strength characteristics.
- Indoor or outdoor installation without removing valve from service.
- Fully mechanical. No electric circuit.
- Position indicator (not shown) shows valve open or closed.
- Adjustable compensation for valve wear.

*TRADE MARK OF BENDIX AVIATION CORPORATION

Products of this division are members of "The Invisible Crew"—precision equipment which 30 Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.

THE INVISIBLE CREW
Precision Equipment by
Bendix Aviation Corporation

BENDIX MARINE DIVISION • One Hanson Place, Brooklyn, New York

Announcing

PANELYTE*

GLASS BASE LAMINATES

possess improved electrical properties...

the ideal insulation for tropical service

Type GMG Grade #140

Panelyte Grade #140 is a glass base melamine sheet which conforms to GMG specifications and is used for instrument panel boards, switch gear mountings, etc. It is supplied in *natural* or *brown*. Its higher cost is more than justified by the advantages of increased resistance to fire, arc and shock and decreased toxicity in case of fire.

Grade #120

Grade #120 is a glass cloth base phenolic sheet for use where Class B insulation is required as in slot wedges and for high temperature insulation. Its use makes reduction in size of motors possible.

Grade #110

Panelyte Grade #110 is a glass mat material with phenolic resin. It finds its greatest use in electronics and communications. Where both temperature and humidity are high, as in the Tropics, the excellent insulating properties of Grade #110 are particularly appreciated. Produced in sheets, rods and tubes, this material can be punched, drilled and sawed.

May we serve you?

Samples, complete technical data, and the services of our Engineering Staff are immediately available.

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
230 PARK AVENUE
NEW YORK 17, N. Y.

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Mexico City, Montreal, New Orleans, Phoenix, Portland, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Toronto, Trenton, Vancouver

*MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS IN PAPER, FABRIC, FIBRE GLASS, WOOD VENEER AND ASBESTOS BASE LAMINATES

POWER

Official U. S. Navy Photograph

BRISTLING with 149 destruction-dealing guns — from giant 16-inch rifles to 20-mm. anti-aircraft batteries — the 45,000-ton battleship Iowa symbolizes the growing might and power of the U. S. Navy. Four sets of geared turbo-electric drives speed the Iowa along at better than 30 knots, making her the fastest as well as the deadliest dreadnought afloat.

In every type of installation — large or small, on land or sea—where turbines are used to generate electrical power, they operate more efficiently, give more dependable service when lubricated effectively. That is why more and more engineers — in hydro and steam plants — use Texaco.

Texaco Regal Oils (R & O) are scientifically designed to prevent rusting of turbine parts. They are highly resistant to oxidation, foaming, sludging and gum formation. Because of these qualities, *Texaco Regal Oils (R & O)* keep turbine systems clean, bearing temperatures normal, governor action smooth and sensitive. They fully meet specifications of all leading turbine builders and the turbine oil specificatons of the U. S. Navy.

Texaco lubricants have proved so effective in service they are definitely preferred in many fields, a few of which are listed at the right.

For suggestions on the proper care of oil and maintenance of turbine systems, call on Texaco Lubrication Engineering Service, available through more than 2300 Texaco distributing points in the 48 States.

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ *More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

★ *More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.*

★ *More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.*

★ *More revenue airline miles in the U. S. are flown with Texaco than with any other brand.*

★ *More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.*

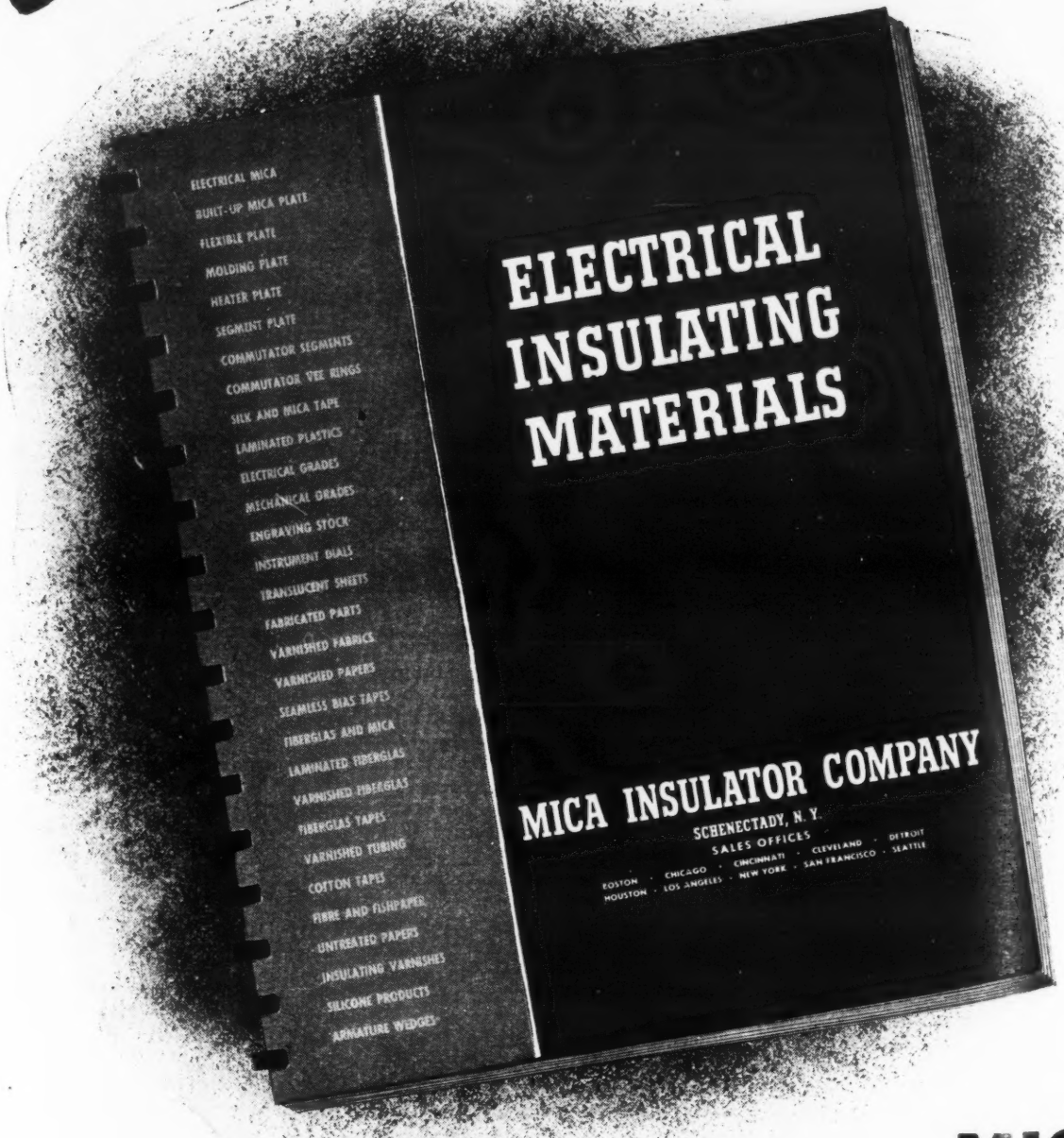
TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON SUNDAY NIGHTS ★ METROPOLITAN OPERA BROADCASTS SATURDAY AFTERNOONS

A New Handbook



MICA

ON INSULATING MATERIALS

for

- MANUFACTURERS
- DESIGNERS
- ENGINEERS

Prepared from the cumulative experience of fifty years in the manufacture of electrical insulation, the Mica Insulator Company offers "Electrical Insulating Materials"—its new handbook for those who use insulation.

Profusely illustrated, the eighty-six pages of this highly informative handbook contain many important facts about sheet mica... built-up mica... laminated plastics... varnished fabrics... papers and other types of insulation manufactured and distributed by the Mica Insulator Company and its five divisions. Manufacturers, designers and engineers will find it a useful guide to the selection of proper insulating materials and their fabrication.

Your complimentary copy of "Electrical Insulating Materials" will be mailed promptly on receipt of a request on your company's letterhead.

SALES OFFICES:

BOSTON • CHICAGO • CINCINNATI • CLEVELAND • DETROIT
HOUSTON • LOS ANGELES • NEW YORK • SAN FRANCISCO • SEATTLE

FACTORY:
SCHENECTADY, NEW YORK

Insulator **COMPANY** 200 Varick Street New York 14, N. Y.

HARVEL 612-C

DOES NOT SUPPORT FUNGUS GROWTH*

Photograph illustrates the fungus resistance of Harvel 612-C Baking Varnish. Note that the fungus culture of chaetomium globosum has not attacked the sample film of Harvel 612-C.

Fungus Resisting Properties protect electrical equipment

Electrical equipment operating in humid atmospheres, must be protected against the constant danger of the attack of fungus growth. This growth has been known to cause failure of electrical units within a few hours under severe tropic conditions.

Guard against fungus growth! Use Harvel 612-C Baking Varnish on component parts of radios, instruments, generators, motors, etc., and increase the life and usefulness of your equipment many-fold.

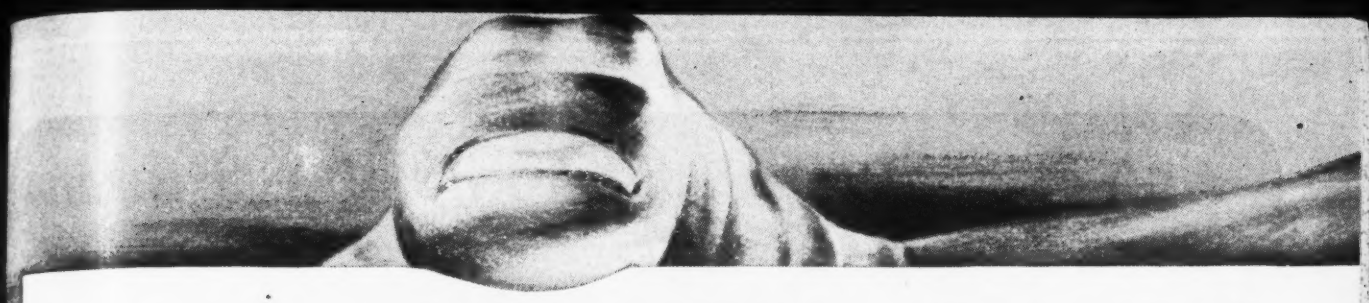
Where an air-drying fungus resistant varnish is desired, use Harvel 902-F. This type, like Harvel 612-C, does not support fungus growth.

Complete information and a free sample of either Harvel 612-C or Harvel 902-F varnish will be sent on request. Write Dept. 46.

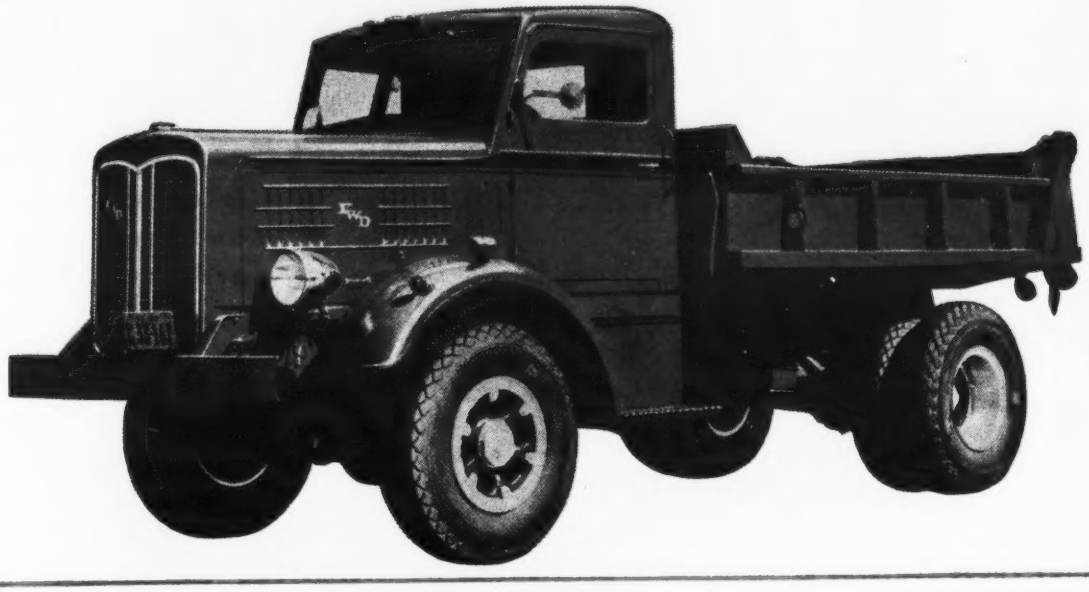
**Tested by the U. S. Testing Laboratories in accordance with A. S. T. M. Specification D684-42T.*

IRVINGTON VARNISH & INSULATOR COMPANY
IRVINGTON 11, NEW JERSEY, U. S. A.
Plants at Irvington, N. J. & Hamilton, Ontario, Canada • Representatives in 20 principal cities

EXTRUDED PLASTIC TUBING • FIBRON PLASTIC TAPE • CARDOLITE RESINS
HARVEL & IRVINGTON INSULATING VARNISHES • VARNISHED INSULATIONS

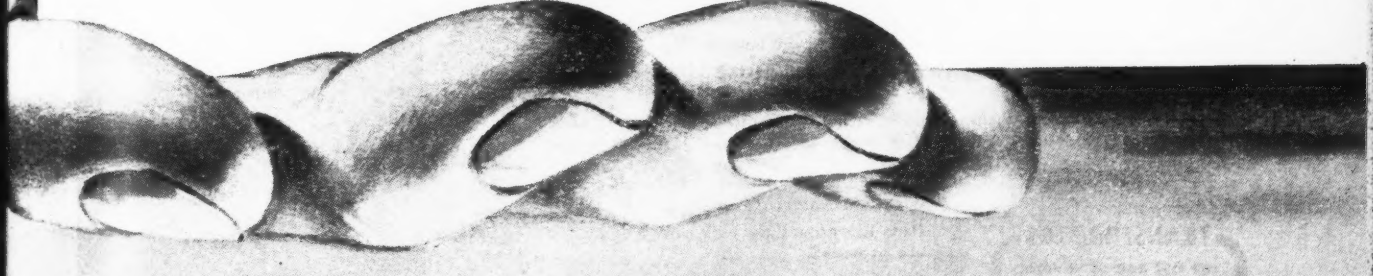


Another Great Leader in a Great Line... FWD's Model SU



Famous 5-Tonner Tops

$ 75,000,000^{00} ENDORSEMENT



When a single model of a heavy duty truck is purchased in volume reaching a total dollar value of $75,000,000.00 in less than four years time, it rightfully gains leadership in its field. FWD's Model SU has won an extraordinary recognition—the endorsement of motor truck buyers exemplified in $75,000,000.00 worth of trucks bought and used since 1940.

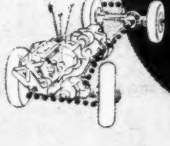
It is significant, too, that in a comparatively brief period of years this single model FWD has a background of $75,000,000.00 in manufacturing experience as well. In every sense it is a great leader in a great line of trucks.

The FWD model SU represents the most advanced development of the four-wheel-drive principle originally pioneered and sponsored by FWD since 1910. It is eminently qualified in every element of design and construction to render service of a character and extent far beyond that of any other truck.

More than ever before essential industries and motor transport organizations rely on Four-Wheel-Drive hauling power to do more work—cover more miles—at lower cost for gas—oil—tires—replacements.

When your need is dependable all-season, all-weather hauling power—look to FWD's—a great line of trucks.

THE FOUR WHEEL DRIVE AUTO CO.
Clintonville, Wisconsin
Canadian Factory: KITCHENER, ONT.

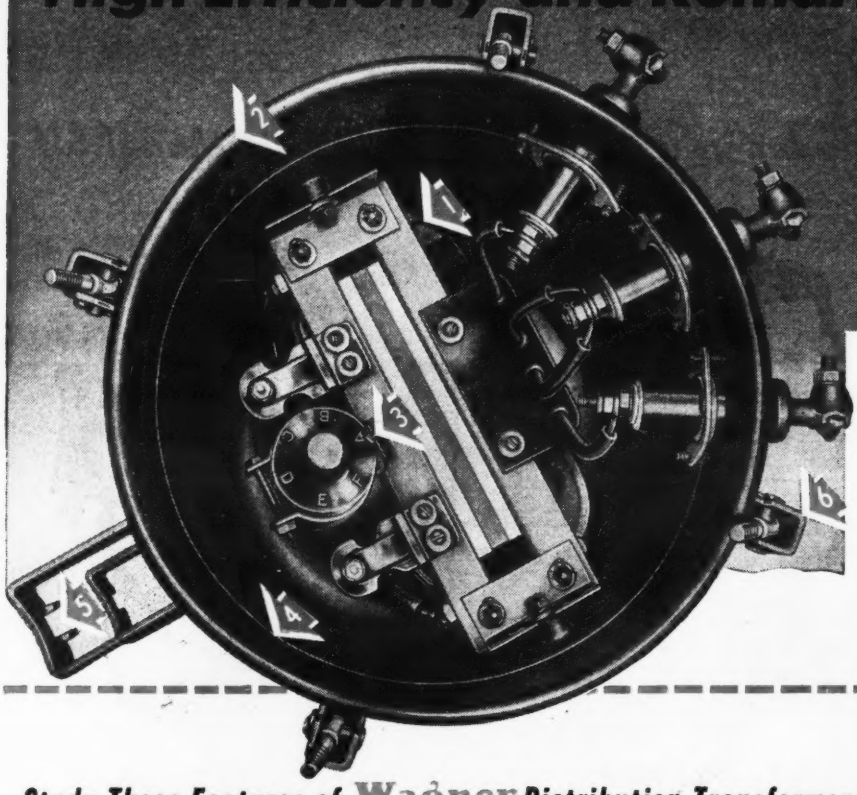


FWD TRUCKS

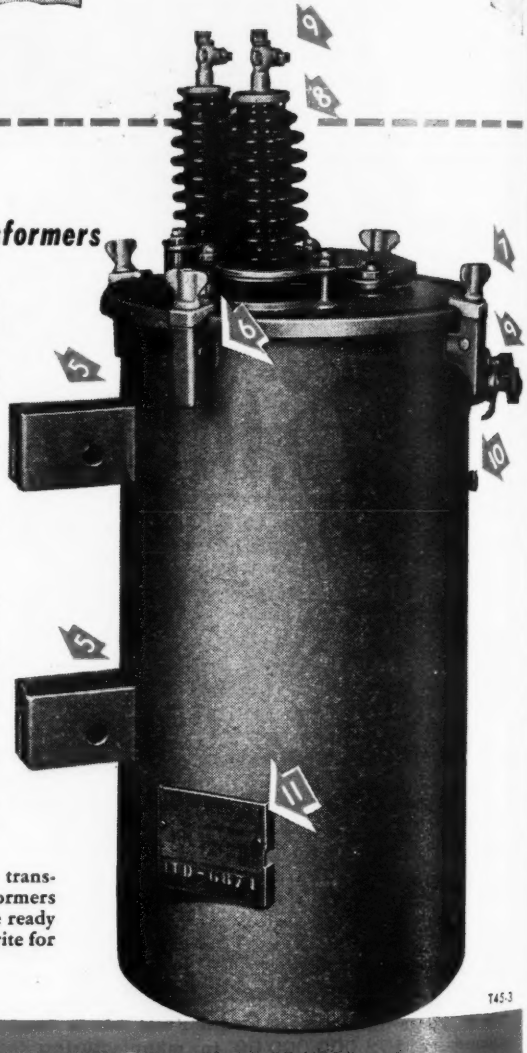
EST AND ORIGINAL EXCLUSIVE

BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS

High Efficiency and Remarkable Stamina are built into Wagner DISTRIBUTION TRANSFORMERS



...They embody the latest developments and meet all standard specifications...



Study These Features of Wagner Distribution Transformers

1. The core and coils of all Wagner distribution transformers are of the high-efficiency type, carefully wound, insulated, and treated to give years of uninterrupted service. Note liberal clearances on terminal boards and between element and tank.
2. Tank is of copper bearing sheet steel with all joints electrically welded. Top edge of tank is rolled to give added strength and to provide wide surface for cover gasket.
3. Snap-action tap changer with operating handle and position indicator above oil level. Because of the "snap action" it is impossible to leave tap changer open.
4. Plainly marked oil-level ring on inside of tank.
5. Standardized direct pole-mounting brackets. "T-crossarm Hangers" and "Kickers" are available for crossarm mounting.
6. Heavy, rugged lifting-lugs are solidly welded to the tank wall.
7. The cover can be easily removed by loosening the wing nuts and rotating the cover clamps.
8. Latest design stud-type bushings easily removed. Photo shows type HEBK with HV cover bushings, but type HEX is also available with HV pocket-type bushings.
9. Standardized solderless connectors on all bushing terminals.
10. Pads for grounding tank and LV neutral are provided.
11. Standardized nameplate pad with space for customer's identification plate located so as to be easily read from pole.

In addition to a complete line of distribution transformers, Wagner can also supply power transformers and unit substations. Wagner field engineers are ready to assist you in all transformer requirements. Write for complete literature.

TRANSFORMERS
are but one of several
WAGNER PRODUCTS

Other WAGNER PRODUCTS:
AIR BRAKES
•
BRAKE LINING
•
HYDRAULIC BRAKES
•
INDUSTRIAL BRAKES
•
INDUSTRIAL BRAKE CONTROLS
•
TACHOGRAPH (Recording Speedometer)
•
ELECTRIC MOTORS

T45-3

Wagner Electric Corporation
ESTABLISHED 1891
6456 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

SIMPLEX-ANHYDREX UNDERGROUND CABLES

NEED NO PROTECTION FROM *Moisture*

Underground cables for electrical distribution are exposed to moisture which can cause a lot of trouble and seriously interefere with service. Metallic sheaths will keep moisture out of the cables but they often create other problems of electrolysis, corrosion, sheath losses and maintenance. A flexible, non-metallic covering, such as a rubber sheath, that will not absorb water is the ideal protection.

Simplex-ANHYDREX Underground cables are now made with synthetic insulations and sheaths that are suitable for underground service in ducts or directly in the ground. Exposure to moisture, even permanent submersion in water, has no effect upon their electrical stability. For steady, uniform underground distribution Simplex-ANHYDREX Underground cables are what you need.

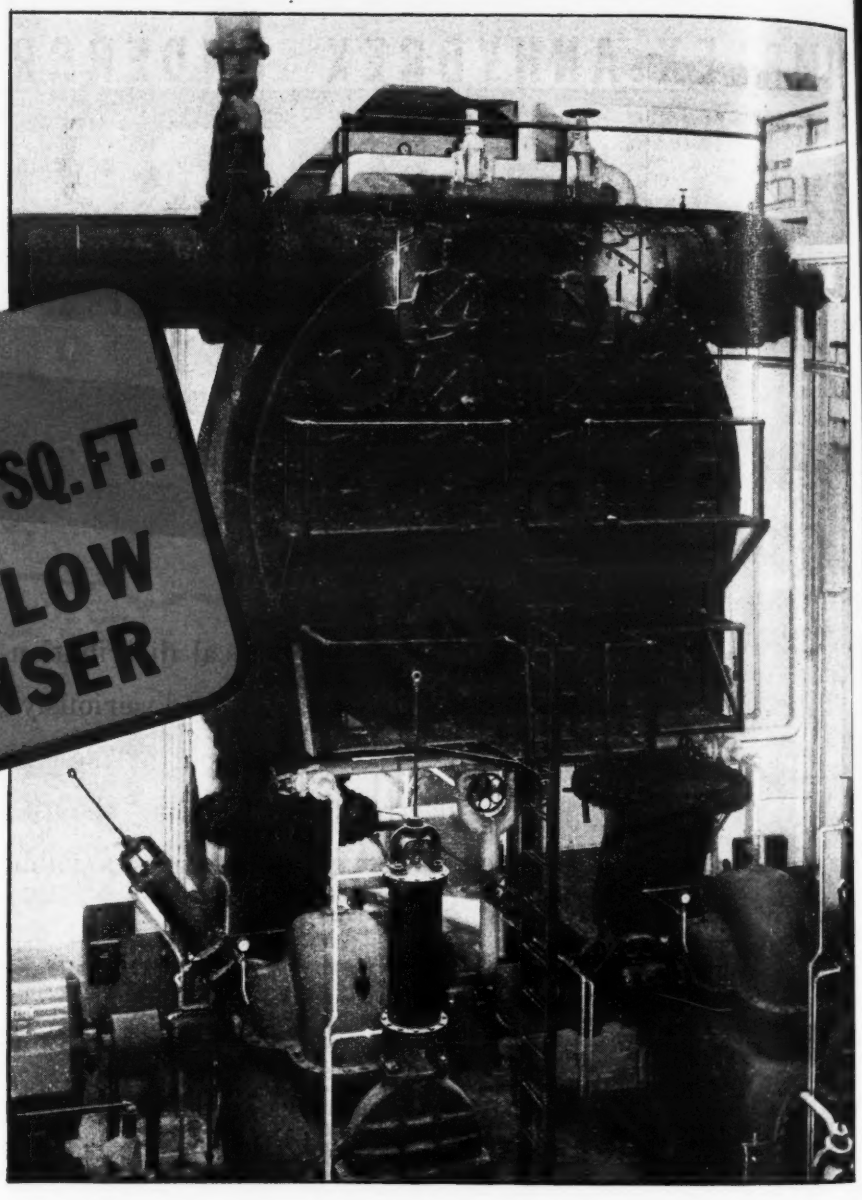
Our experience with low water absorption insulations over many years is at your service whenever moisture creates a cable problem for you.

Buna S has replaced natural rubber in Simplex insulations.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

Simplex

WIRES and CABLES



36,850 SQ. FT. DIRECT FLOW CONDENSER

THE recent extension to the Market Street Steam-Electric Station of the New Orleans Public Service Inc. at New Orleans, includes a 37,500 KW turbo-generator and the two-pass, direct flow, divided waterbox condenser illustrated above. Cooling surface consists of condenser tubes 22 feet 3 inches long.

The two 30-inch horizontal circulating pumps shown in the foreground are of the double suction type, each having a capacity of 19,550 GPM.

Condenser and pumps were designed and built by Foster Wheeler.

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

FOSTER FW WHEELER

2 Reasons why

RED LEAD

means Extra Rust Protection . . .

Why is Red Lead so widely accepted throughout industry as *The* metal protective paint?

Why are paints containing Red Lead so generally specified for safeguarding metal surfaces from the costly ravages of rust?

The reasons are many, but none are more noteworthy than Red Lead's ability to counteract acid conditions and to halt electrochemical action—both prime causes of rusting—as explained at right.

Still another important advantage of Red Lead is that it partially combines with the usual vehicles to form compounds generally known as "lead soaps." Due to their composition and the individual way in which these compounds form, the film obtained is highly water-resistant. In addition, lead soaps contribute to the formation of tough, elastic films that "stick on the job."

Remember, too, that Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including phenolic and alkyd resin types.

Specify Red Lead for ALL Metal Paints

The value of Red Lead as a rust preventive is most fully realized in a metal paint where it is the only pigment used. However its rust-resistant properties are so pronounced that it also improves any multiple pigment paint. No matter what price you pay, you'll get a better metal paint if it contains Red Lead.

NEUTRALIZES ACID

1 Red Lead has the ability to counteract acid conditions which are recognized as accelerators of rust. Structural steel is exposed to such environments because acid forming compounds are carried by the atmosphere in the form of gas, smoke and moisture. Red Lead has a neutralizing effect on these conditions as it is essentially a *basic* pigment with the ability to develop and maintain, for a prolonged time, a mild alkaline environment at the surface of the metal. Authoritative tests show that, as a result, Red Lead inhibits the process of corrosion. In short, metal paints, too, should "stay on the alkaline side."

2 Another outstanding reason Red Lead means *extra* rust protection is the unique way it shields metal surfaces with a protective film. Rusting is fundamentally an electrochemical process in which weak currents are generated which cause iron to become soluble in the lowest state of oxidation. Red Lead has properties through which this iron is rapidly converted to a stable compound that forms an adherent film. The formation of this protective shield halts electrochemical action, thus preventing further corrosion.

Write for New Booklet

"*Red Lead in Corrosion Resistant Paints*" is an up-to-date, authoritative guide for those responsible for specifying and formulating paint for structural iron and steel. It describes in detail the scientific reasons why Red Lead gives superior metal protection. It also includes typical specification formulas. If you haven't received your copy, address nearest branch listed below.

* * *

The benefit of our extensive experience with metal paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6, Buffalo 3, Chicago 10, Cincinnati 3, Cleveland 13, St. Louis 1, San Francisco 10, Boston 6 (National-Boston Lead Co.); Pittsburgh 30 (National Lead & Oil Co. of Penna.); Philadelphia 7 (John T. Lewis & Bros. Co.)

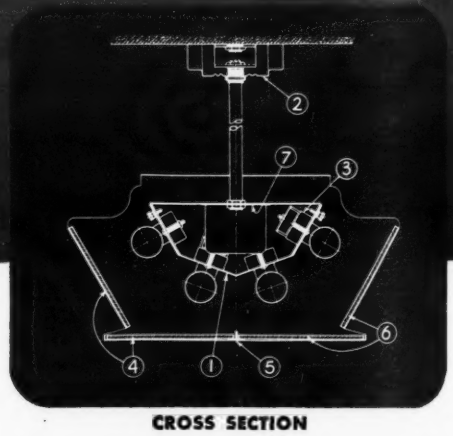
DUTCH BOY RED LEAD

Pittsburgh Permaflector Fluorescent Luminaires

combine

Good Lighting with Good Taste

This shielded type 4-40 watt Fluorescent Luminaire typifies the combination of engineered lighting with beauty of design. Light is controlled, maintenance made easy; mounting is flexible—may be individual, continuous, direct ceiling or suspension.



CROSS SECTION

THIRTY-THREE years of experience manufacturing *engineered* lighting equipment assures the maximum efficiency of *Permaflector Fluorescent* Luminaires.

And something *else* has been added . . . *good taste* . . . design that is functional yet beautiful in its simplicity and dignity. The same qualities of restraint that mark good design, whether in decoration or architecture, are inherent to the Pittsburgh Fluorescent line.

Permaflector engineers have built into these new Fluorescent Luminaires features that make installation and maintenance easier. Full technical information regarding these new Fluorescent Luminaires or the complete line of Permaflector Incandescent Equipment is yours for the asking.

7 Points of Positive Superiority

1. Light distribution controlled by reflector. Reflector removable for access to wiring channel.
2. Hanger provided with fittings that prevent unit from swinging out of alignment.
3. Lamp holders securely mounted in separate mounting strap.
4. New types of iridescent glass panels full length of unit—easily removable for maintenance.
5. Metal strip rigidly supports glass panels.
6. Contrasting glass panels add to beauty of design.
7. Reinforcing steel plate.

"Pittsburgh" Permaflector

Pittsburgh Reflector Company

OLIVER BUILDING · PITTSBURGH, PA.

★Manufacturers of Permaflector Lighting Equipment, distributed by recognized electrical wholesalers everywhere.

Representatives in Principal Cities

BLACKBURN *Hy-Strength* CONNECTORS

In a Nutshell—

Here are the 7 Advantages that Cut Your Maintenance Costs!

- They're the strongest and most durable connectors made. That's because they're the only line of connectors made of DURONZE, which tests show is 75% stronger than hard-drawn copper, and more non-corrosive than pure copper.
- Because of this exclusive high-strength construction, BLACKBURN CONNECTORS will not distort, and can be used over and over again —a real economy.
- Conductivity of the joint is actually better than the solid wire itself.
- Reinforced pressure bar makes a strong connector still stronger.
- All corners rounded—will not nick wires or cut lineman's glove.
- Machined to close tolerances, assuring accurate fit of nut and maximum strength of thread.
- Full threads on screw for maximum strength.

In short, BLACKBURN Hy-Strength CONNECTORS are trouble-free on the line, and definitely cut your maintenance expense. Yet they cost no more than ordinary connectors.

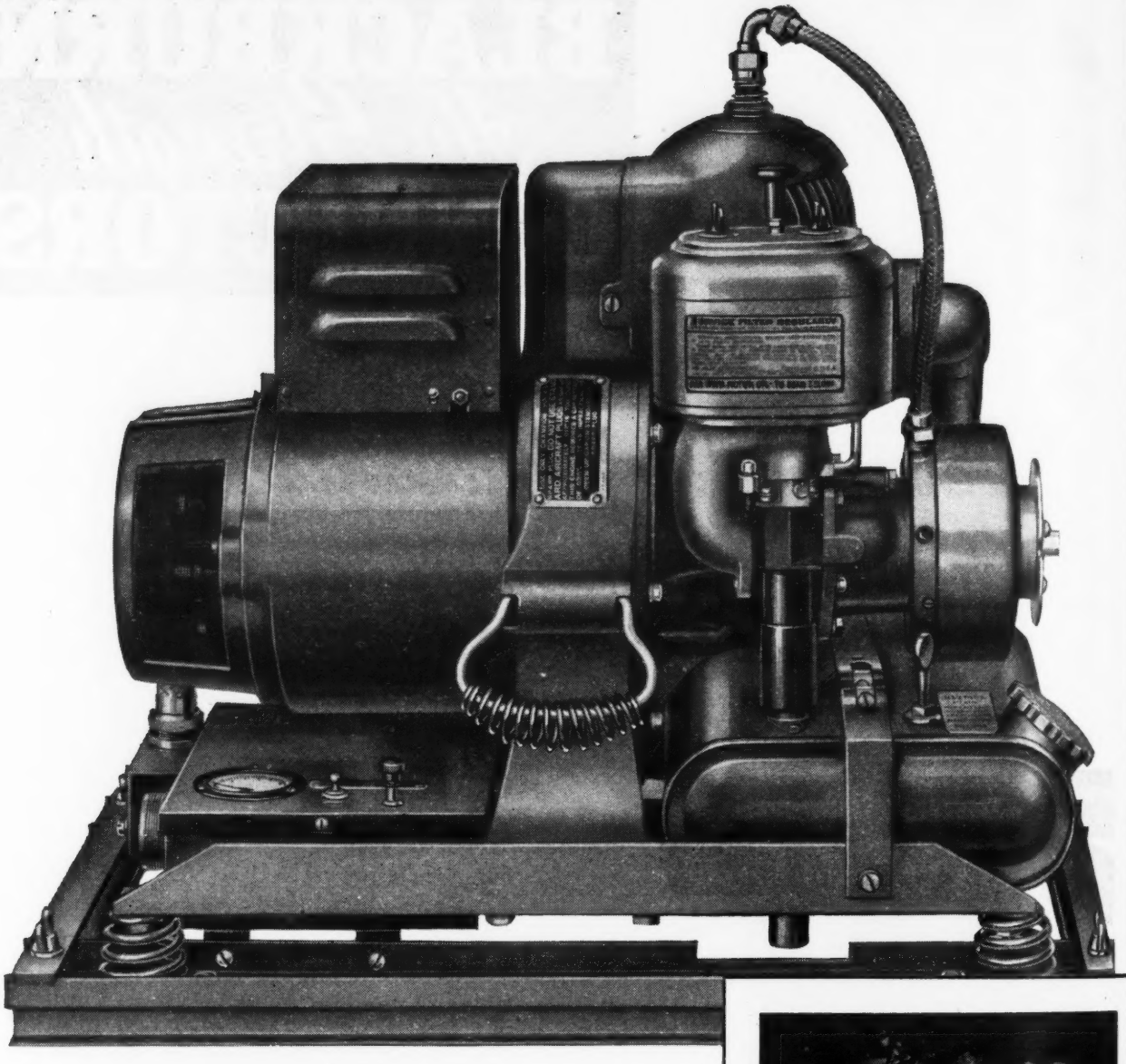
Millions in use throughout the world

Over 100 Conveniently-located Jobbers' Stocks

JASPER BLACKBURN PRODUCTS CORP.

Main and Clinton Sts. • ST. LOUIS (6), MO.

Builders of Quality Connectors for Over 10 Years

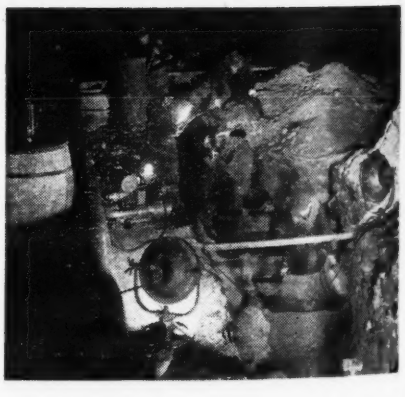


It has to work alone and like it

No and's, if's or but's about it, a Homelite Portable Generator, installed in a plane or a tank is in no position to receive nurse-maid attention. It's usually crammed into some hot, tight corner where it is practically impossible to service it.

Which means just one thing . . . a Homelite Generator with its built-in gasoline engine has to work and stand up under the toughest kind of usage . . . hours on end . . . without receiving any attention or service. To meet demands like this . . . born of war . . . Homelite engineers have developed a higher powered, lighter-weight and, above all, a more dependable gasoline-engine-driven generator . . . a compact, portable Homelite that will meet and pass the performance requirements of any peace-time job.

HOMELITE CORPORATION
PORT CHESTER, NEW YORK



FOR YOUR PEACE-TIME JOBS

The new Homelite Portable Generators that you will use after the war for operating brilliant floodlights or electric tools will work better in winter and summer. They will be more dependable even under the toughest operating conditions. They will work longer hours without attention or service . . . and will be more rugged and powerful than ever before.

Portable Pumps - Generators - Blowers

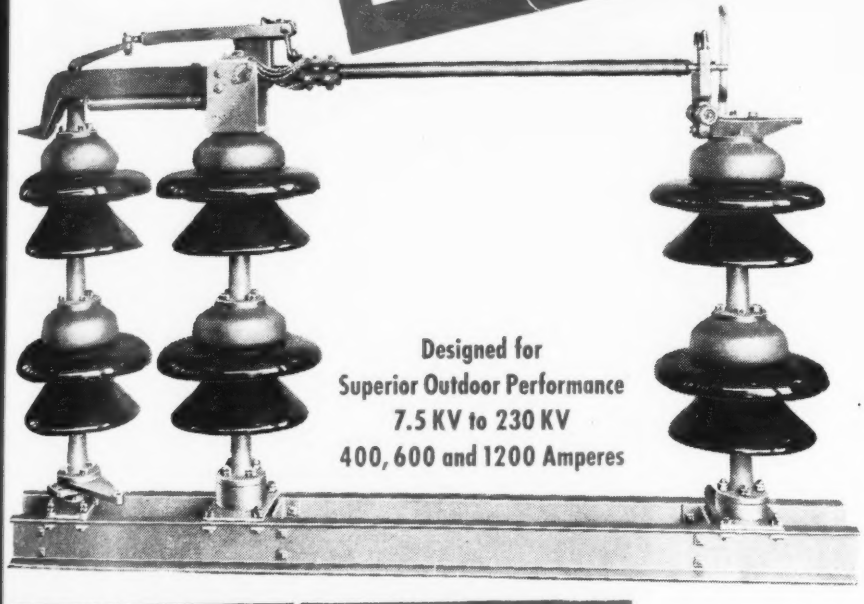
For SUBSTATION RELIABILITY

here's the PACIFIC ELECTRIC SWITCH

TYPE T W

Blade Correctly in Position . . . before it

ROTATES IN AND OUT OF HIGH-PRESSURE CONTACT, **MAKING OPERATION EASY**



Designed for
Superior Outdoor Performance
7.5 KV to 230 KV
400, 600 and 1200 Amperes

1. Blade in partial open position.
2. Switch blade coming into position.
3. Closed position. Blade rotated to apply contact pressure. Strong springs apply full pressure over a wide range of contact deflections.

C. H. Cutter, 1015 Securities Bldg., Seattle, 1, Wash.
J. E. Redmond Co., 448 W. Madison St., Phoenix, Ariz.
F. W. Gorman, P. O. Box 223, El Paso, Texas
G. B. Kirkwood, 437 S. Hill St., Los Angeles 13, Calif.
Other Representatives in Principal Cities

For the most reliable performance at outdoor power stations, here is an especially-well-designed group-operated vertical-break switch for line, bypass, sectionalizing or circuit use.

When the switch blade swings into correct position, it rotates into a high-pressure hinged contact. Wiping action is sufficient, yet wear of silver inserts is negligible.

Tests show that this type of contact wears but 1/64-inch per 15,000 operations.

Under heavy ice conditions, this switch *progressively* fractures ice, starting with the operating handle, through the bevel-link drive to the rotating blade. In this way the mechanism is freed from ice before the opening or closing of the switch blade. The contact pressure is released by the rotation of the switch blade permitting easy opening under all conditions.

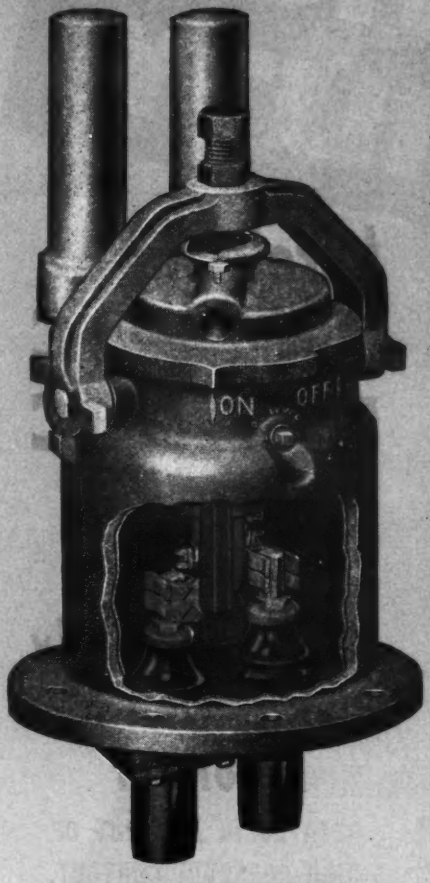
Other features include the simple design; toggle in closed position; anti-friction bearings; enclosed spring counterbalance for the blade on the larger sizes; and two easy adjustments, one for positioning the blade and one for rotating the blade.

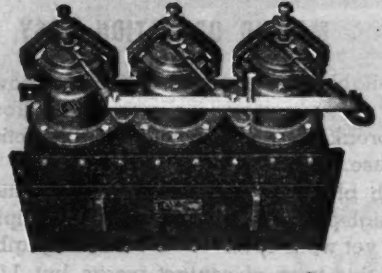
For full details about this most reliable substation switch write today.

Pacific Electric Mfg. Corporation

815 THIRD ST., SAN FRANCISCO 24, CALIF. P. O. BOX 419, GARY, INDIANA

STYLE "B"
With gasketed flange for mounting on boxes.





The years of trouble-free service has created a wide acceptance of G & W Type "FC" Oil Fuse Cutouts. The modern design provides interchangeability of parts for various installation conditions. The interlocking cover and cover clamp insures safety in fuse replacement. The simple and inexpensive fuse link universally fits all Type "FC" cutouts.

½ cycle interruption of short circuits protects equipment.

Beryllium copper springs make ideal full load break switching contacts.

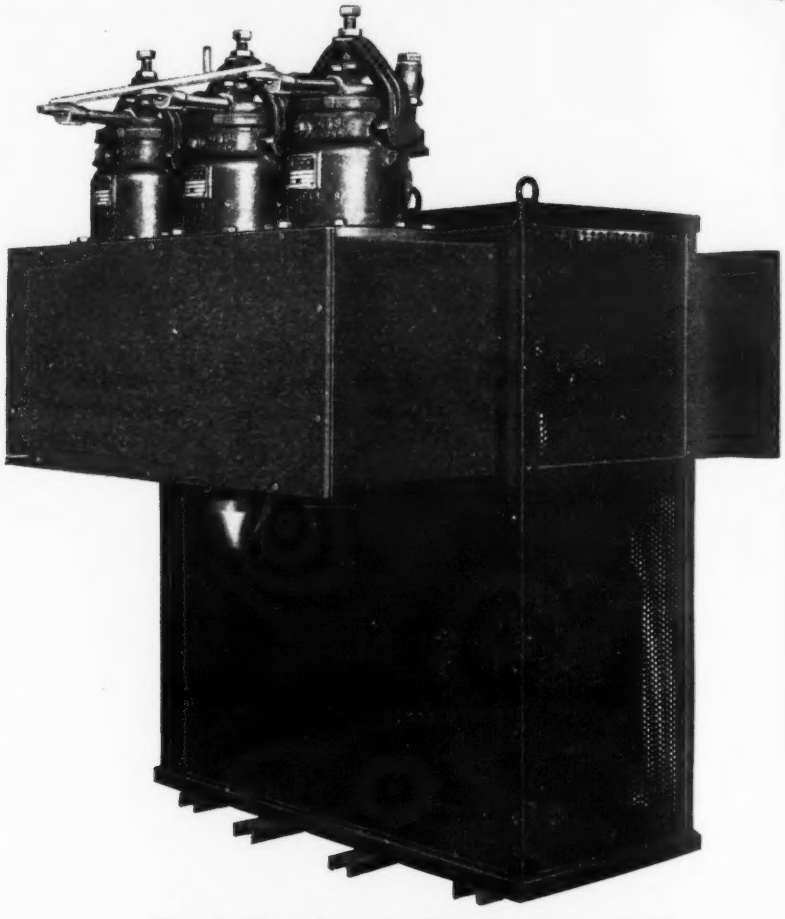
Save Installation Labor

By Specifying

G & W TYPE "FC" OIL FUSE CUTOUTS

on your transformers

FULL COOPERATION WITH TRANSFORMER MANUFACTURERS IS ASSURED



Davis Transformer Co., Concord, N. H.
DRY TYPE TRANSFORMER
Equipped with G & W No. FC31B oil fuse cutouts.

Secure the advantages of complete unit metal enclosed construction with CUT-OUT BOX attached to the transformer.

Installation labor is reduced by merely terminating the feed cables in potheads (*also made by G & W*) or within the cut-out insulators inside the box. Conduit connections can be made on the pothead or directly on the box.

An economical primary load-break oil switch with overload and short circuit fuse protection.

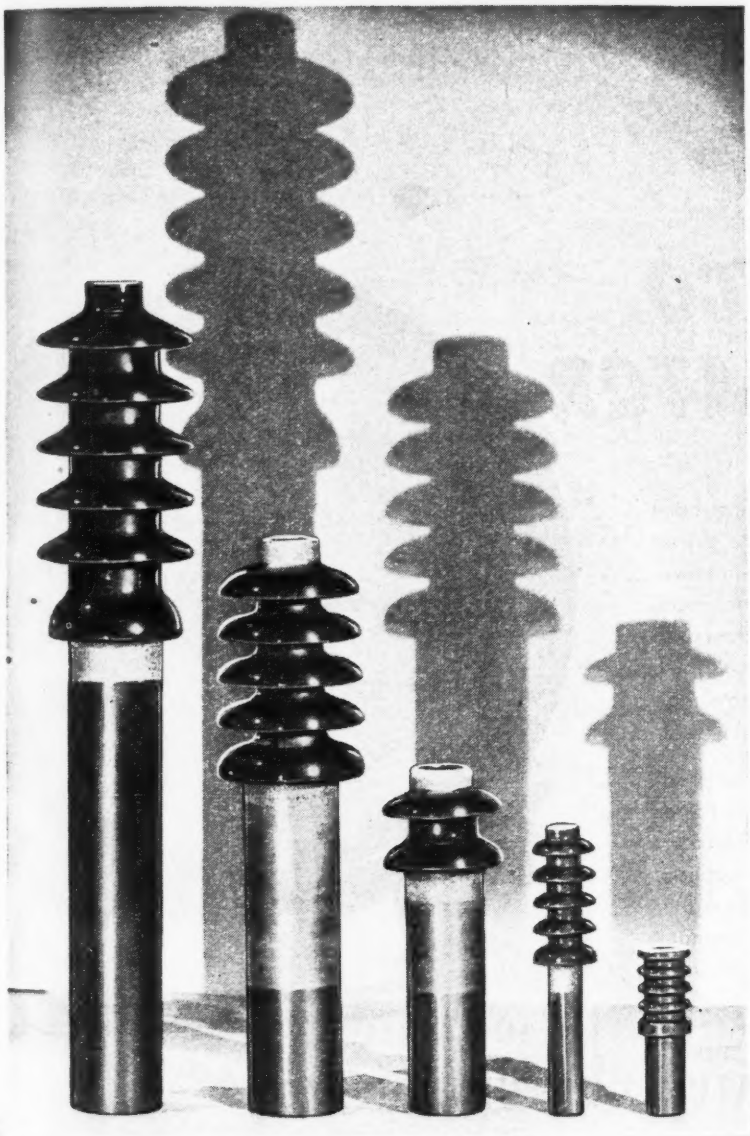
Send for Bulletin 425

G & W ELECTRIC SPECIALTY CO.
7780 DANTE AVENUE • CHICAGO 19, ILL., U. S. A.

In Canada—Powerlite Devices, Ltd., Toronto

GANG OPERATED } **FOR FUSING AND SWITCHING PRIMARY CIRCUITS SUBWAY—OVERHEAD—VAULTS**

ILLINOIS *Porcelain*
TRANSFORMER BUSHINGS
made to customer's specifications



THESE bushings are not carried as standard stock items but are made in accordance with specifications furnished by customers. Each individual need is thereby specifically provided for and can be duplicated at any time with the assurance of uniformity.

Control of production methods assures uniformity of ILLINOIS Porcelain. Internal Stress is eliminated—exact dimensions are assured—accurate kiln firing prevents strain.

These bushings can be standard glaze or radio interference proof glaze. Dry Type Bushings are made for all voltages up to 34.5 kv. Gasket Seats are smooth and ground when required.

They accurately line up in the transformer case

HIGH DIELECTRIC STRENGTH •• HIGH MECHANICAL STRENGTH
EXACT DIMENSIONS AND UNIFORMITY

ILLINOIS ELECTRIC PORCELAIN CO.
MACOMB, ILLINOIS

NOW . . . FOR THE FIRST INDICATING AND

THE ELPECO LOAD INDICATOR

Electrical Engineers for many years have expressed desire for a moderate priced device to indicate two conditions on power lines: one marker showing present load, another the maximum load reached with a definite time lag. With Elpeco's new Load Indicator you get a true knowledge of your transformer loads.

This new Load Indicator is another product of the well established Electric Power Equipment Corporation. The Indicator, starting at zero with uniform load applied, will show 90% of its maximum load in about 30 minutes. Successive load changes will take approximately the same time to approach the maximum.

FEATURES OF THE INDICATOR

The Elpeco Load Indicator is, in principle, a thermal indicator which denotes electric power loads by passing of current through a resistor. Its indications respond proportionally to its change in temperature, or the amount of stored heat.

Further, it will show both under and overloaded transformers. An important feature is that those circuits showing an excessive no-load loss will be so indicated, thus saving that loss which goes on every minute of the year, and enable the proper shifting of transformers to more effective location as a result of these readings. *Individual problems of iron and copper losses can be studied in accordance with size and type of system.*

By use of Elpeco's Indicator there is eliminated possibility of danger to the transformer from overloading, thus saving expensive repairs and loss of service of transformer and continuity of circuit to customers.

TIME...AN ECONOMICAL DEVICE FOR RECORDING LOADS ON YOUR SYSTEM

YOU GET THESE SAVINGS—

1. Certain transformers will be found underloaded and load not growing. Each of these can be safely replaced with smaller units and the larger units shifted to points of higher growing loads.

2. Other transformers will be found that have passed the full load point with rapidly increasing loads. These must be watched carefully, lest they pass the danger point with resulting costly repairs.

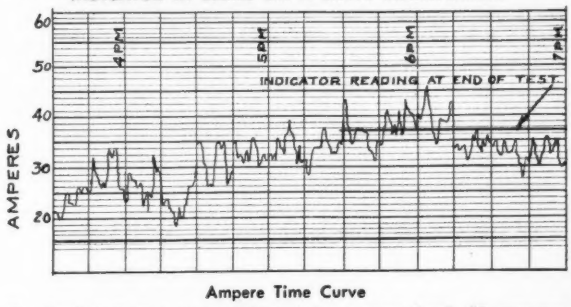
3. Still other transformers have already passed the danger point and should be replaced with larger units.

In serving the Electrical Industry with these Load Indicators, Elpeco adds to its line of Indoor and Outdoor switchgear and devices representing 30 years of experience in the design and production of quality products.

EASILY INSTALLED

Some power companies place the transformer against the poles in the direction of the lines, others place them on the side of the pole toward the street, over the secondary supporting rack. In either instance, Elpeco's Indicator is *easily installed—easily read!*

FIELD CHECK TEST WITH CURVE DRAWING AMMETER AND LOAD INDICATOR IN SERIES ON A 5KVA. TRANSFORMER



Ampere Time Curve

The load indicator was calibrated in percent load, 21 amperes = 100%, which at 240V = 5KVA. The indicator read 170% max. at end of test, equal to 36 amperes. The check is very close.

ELECTRIC POWER EQUIPMENT CORPORATION

PHILADELPHIA 30, PENNSYLVANIA.

Write for ***FREE*** *Bulletin*

YOU will surely profit by clipping this coupon and mailing it today for your FREE COPY of the new Bulletin #4600 describing Elpeco Load Indicators.

ELECTRIC POWER EQUIPMENT CORPORATION,
412 North Eighteenth Street, Philadelphia 30, Pa

Send me FREE your Bulletin #4600 describing Elpeco Load Indicators.

Name.....

Address.....

City.....

Company..... State.....

Position.....

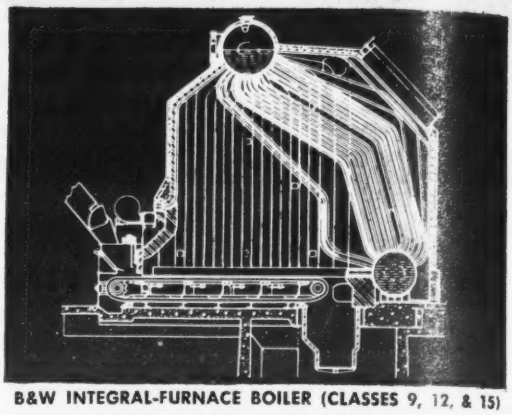
PRACTICAL PLANS for

In the wake of this war will come new jobs for steam . . . new opportunities . . . new problems . . . keener competition . . . that will put renewed emphasis on power plant reliability, efficiency, and operating costs.

When the urgency of war production begins to unwind into the pattern of peacetime competition, power plant engineers will want to be ready in advance with step-by-step plans for urgently needed modernization and expansion of existing facilities. Properly drawn, such plans will help speed reconversion of their own industries and hasten action in providing for fully integrated power services having the high overall efficiency and flexibility for changing conditions that future operations will demand.

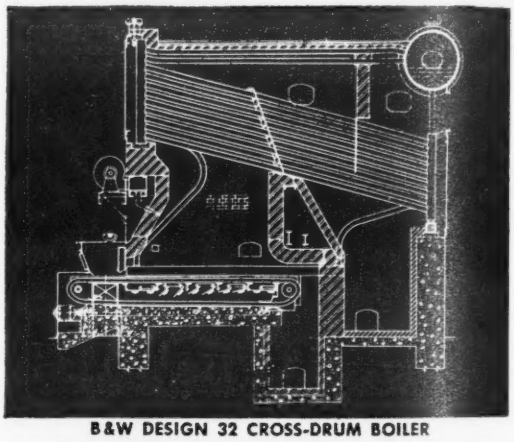
Thinking and planning for tomorrow *today* is a job B&W engineers are ready to tackle in partnership with power engineers of industry. Their long leadership in meeting steam power requirements has been greatly augmented by much more valuable experience gained in serving the industry war needs.

When the time comes to specify equipment for the future, there is a B&W boiler for any combination of conditions . . . capacity, pressure, temperature, feedwater, fuel and space . . . to be met. Whatever the type needed, it is built for the job, thus assuring the highest standards of performance, continuity of service, high overall station economy and greatest return on the investment.



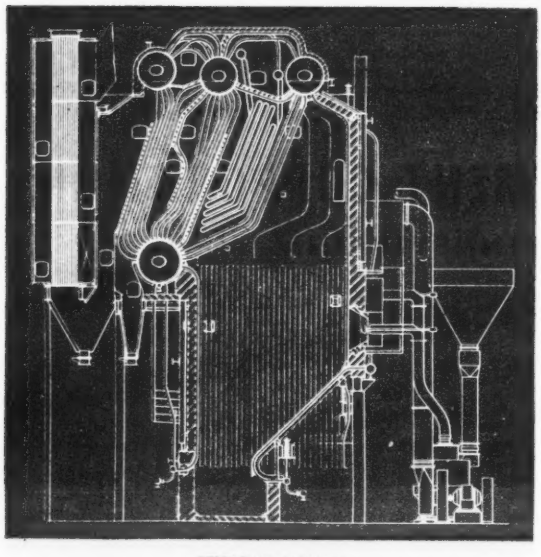
B&W INTEGRAL-FURNACE BOILER (CLASSES 9, 12, & 15)

This Integral-Furnace Boiler is available for firing with stokers or with oil, and in sizes ranging from 1353 to 6506 sq. ft. of heating surface. Having a water-cooled furnace of special design, this boiler provides the dependability of central-station boilers, with efficient and smokeless combustion.



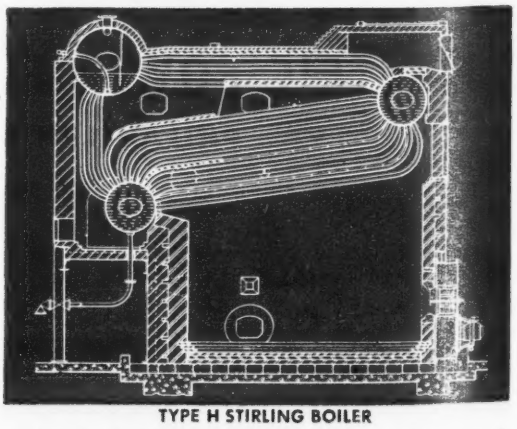
B&W DESIGN 32 CROSS-DRUM BOILER

This unit is widely used in small and medium-size power plants where refractory furnaces are suitable. It provides the advantages of the straight-tube, sectional-header construction used in B&W Cross-Drum Boilers designed for larger capacities.



STIRLING BOILER

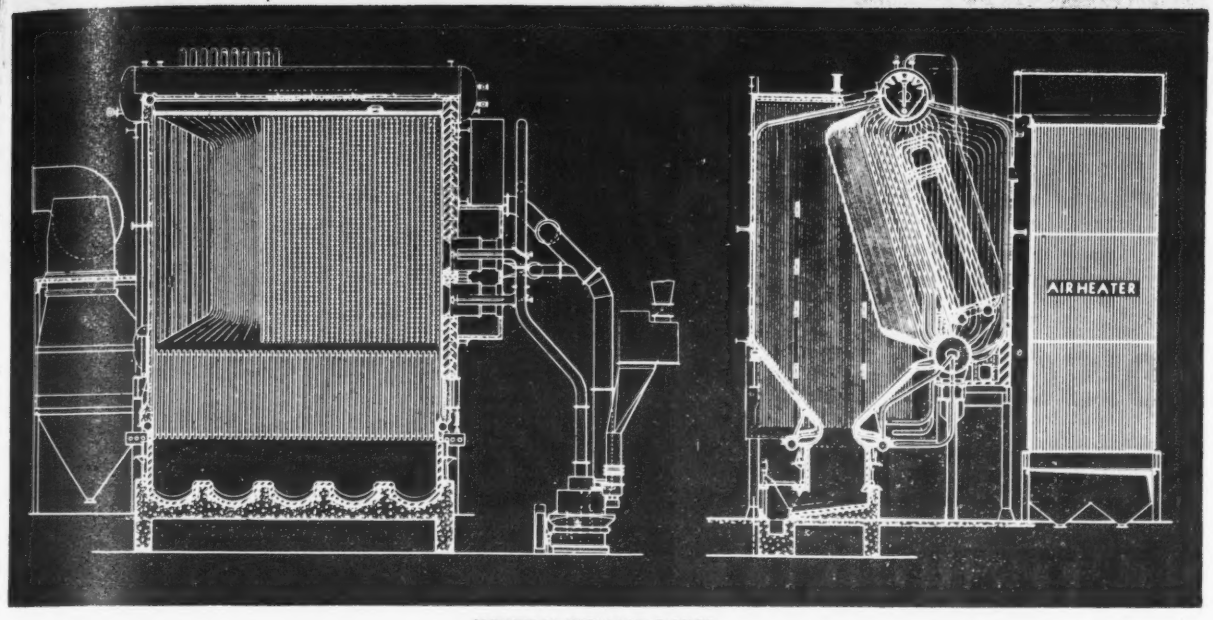
The Stirling Boiler fully meets the requirements of modern operating conditions. It readily responds to sudden and heavy demands for steam, and delivers dry steam at relatively high ratings when operated with water having a high concentration of solids. May be fired with any fuel.



TYPE H STIRLING BOILER

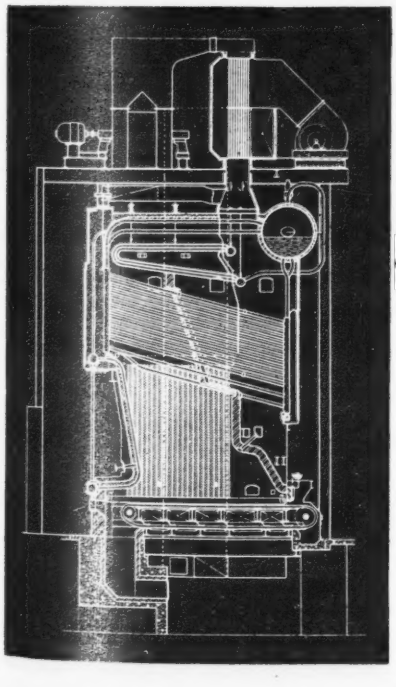
A low-head moderate-pressure unit that is widely used in small industrial plants, institutions, hotels, office buildings and to meet other similar requirements. Available in capacities ranging from 1500 to 30,000 lb. steam per hr. and for firing with any fuel. The furnace, usually of refractory, provides the necessary degree of dependability.

PEACETIME POWER . . .



INTEGRAL-FURNACE BOILER

The Integral-Furnace Boiler is a completely co-ordinated unit built in capacities up to 250,000 lb. steam per hr. and for the pressures and temperatures required by the most up-to-date and efficient prime movers. It is designed to burn pulverized solid fuels, oil, or gas, singly or in combination, thus utilizing at high combustion efficiency the least expensive fuel obtainable in any locality.

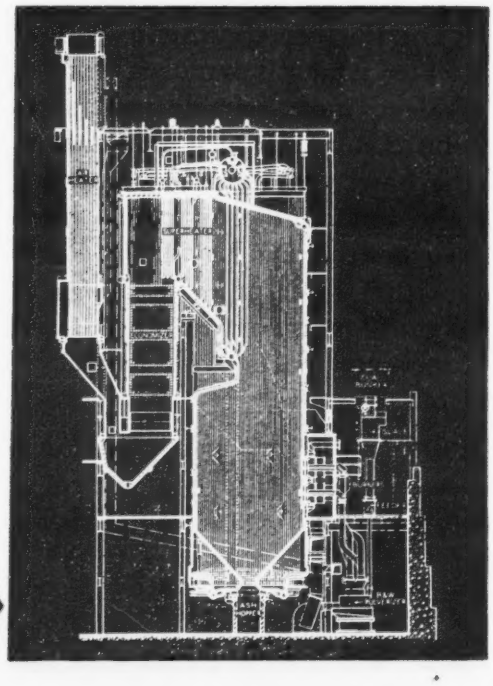


B&W CROSS-DRUM BOILER

This straight-tube sectional-header boiler is noted for its dependability, long life, and ability to deliver dry steam at high ratings. Can be readily inspected and cleaned.

CENTRAL-STATION BOILERS

High-duty boilers for central-station service are available in several basic designs to meet the requirements of individual stations. The Radiant boiler unit illustrated is typical of some of the units now operating at high rates in utility plants.



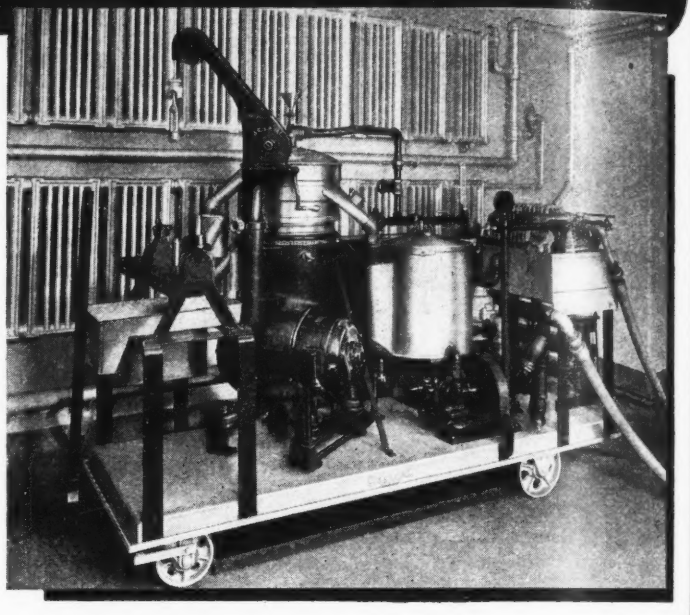
THE BABCOCK & WILCOX CO. • 85 LIBERTY STREET, NEW YORK 6, N. Y.

BABCOCK & WILCOX

G-294F

Safest... Most Reliable Insulating Oil Maintenance-

A DE LAVAL PURIFIER DISCHARGES WATER CONTINUOUSLY



BECAUSE the De Laval centrifugal Oil Purifier continuously discharges the water which it removes from oil, it is the safest, most reliable means of maintaining insulating oil. No water collects in the bowl (purifying member) to ultimately render the machine ineffective. Moreover, the De Laval Oil Purifier removes the water at *constant high efficiency* —no shutdowns for cleaning or renewing of functional parts are necessary during the course of a run.

A De Laval Insulating Oil Purifier restores the required high dielectric value of the oil at a single pass, saving supervision and increasing the daily output of thoroughly dehydrated oil.

Another advantage of De Laval Insulating Oil Purifiers is that they purify the oil at low, non-carbonizing temperatures. A blotter press can be furnished to remove colloidal carbon from circuit breaker oil, the press being arranged in series with the purifier so that it removes the colloidal carbon after the De Laval Purifier has removed the water and other impurities.

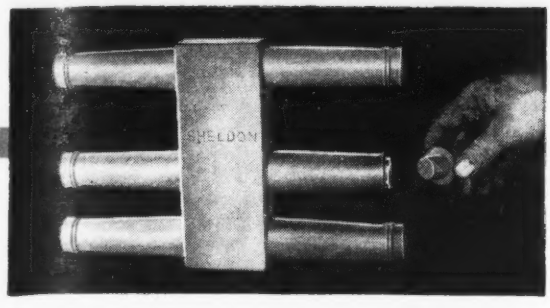
● Write for further information on these De Laval Oil Purifiers, the choice of most of America's largest power systems.

DE LAVAL

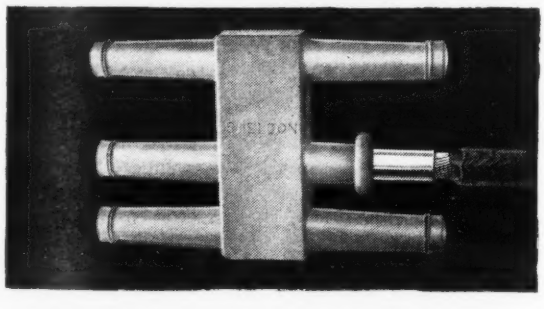
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

...INSULATING OIL PURIFIERS

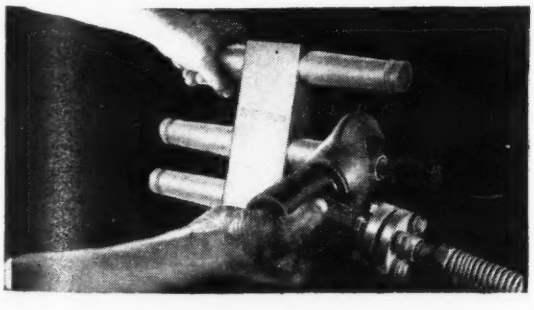
ONLY 4 STEPS
Are Necessary to Install
SHELDON
KOMPRESS CRABS



1. *Remove rubber plug* from cable outlets. Roll back rubber insulation. Beads on end of outlet makes this easy!



2. *Now insert your cable.* Rubber insulation is held back out of your way by small wedge.



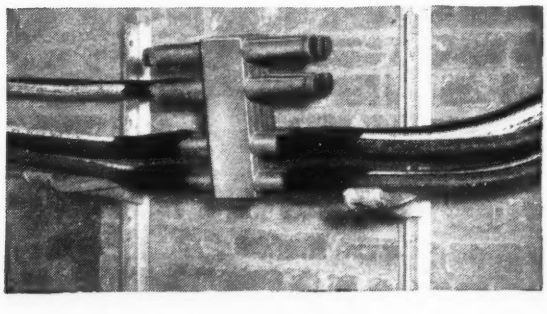
3. *Compress the connector* onto your cable with the Sheldon Kompress and get a permanent joint at low cost.

SHELDON KOMPRESS CRABS offer the most economical way to join two or more underground cables together. They are compact, moisture-proof, trouble-free and labor-saving—with just 4 simple moves to install.

KOMPRESS CRABS are insulated multiple connectors especially engineered for underground cable installations. They take up very little space and are easy to rack. Extra heavy loads of circuits can be carried without exceeding cable temperatures.

For quicker, better, longer-lasting connections specify KOMPRESS CRABS. Write today for catalog and data book. Sheldon Service Company, 652 Hudson Street, New York 14, N. Y.

4. *Clean moisture-proof assembly,* with Kompress Crab installed and cables taped. Spare outlets available for adding connections.



Specify "Sheldon" for Precision-Built Electrical Connectors

SHELDON SERVICE COMPANY

SPLITBOLTS ... LUGS ... COUPLERS ... LIMITERS ... CRABS

Snubbing Type
Strain Clamps
Drop Forged S.A.E. 1035 Copper Bearing
No. 7511
No. 21048
No. 2104
Here
HUNDREDS of thousands of this type of clamp, especially in the larger size, are in use in all parts of this and other countries. They are the familiar and accepted snubbing type, designed for dead-ending the lighter duty transmission and distribution lines. Low in price, they are especially adapted to rural electrification work.
The use of forged steel parts results in a light-weight clamp with more than adequate strength. This feature, together with the short connection length, protect the conductor from the possible effect of vibration.
The ample radius of smth. smooth cable seat and long clamping keeper prevent damage to the conductor and the side opening type is easy to install and work with hot line tools. Reversible two-groove keepers accommodate a wide range of conductor sizes
No. 7511 (without thimble). No. 7548 (with thimble).
For all conductors within its size range.
Min. 0.16—Max. 0.55
Not recommended for A. C. S. R. conductors larger than No. 2.0 due to their stiffness.
Ultimate strength 10,000 lbs. Shpg. wgt. 280 lbs. per C.
No. 2104 (without thimble). No. 21048 (with thimble).
For all conductors within its size range.
Min. 0.187—Max. 0.50
Especially adapted to No. 2.8 strand and No. 4.8 strand A. C. S. R.
Ultimate strength 9,000 lbs. Shpg. wgt. 200 lbs. per C
No. 2102 (without thimble).
For all conductors except A. C. S. R. within its size range.
Min. 0.128—Max. 0.375
Ideal for the popular Aluminum Copperweld-copper other similar three-strand composite conductors.
Ultimate strength 7000 lbs. Shpg. wgt. 145 lbs. per C.
Side Opening Clevis Thimble
For Angle and Strain Position
No. 2400
Suitable for all conductors generally used on Rural and Light duty transmission and distribution lines.
Note provision for the tie wires at each side of the lower part of the thimble. May also be used as a dead end thimble. Very light in weight with more than adequate strength. Side opening allows easy installation
Ultimate strength 9000 lbs. Shpg. wgt.
Angle
Nos. 2200 and 2300
Especially designed for construction having a 30 degrees to 120 degrees. Suitable for all commercial sizes of conductors from .12 to .60 diameter, including armor rod or ribbon.
The three inch seat contour radius meets the requirements for A. C. S. R.—Copper, Copperweld, Copper Composite and other conductors. Side opening—easy to install or work with hot line tools. Unnecessary to remove the T-Bolt keeper during installation.
Ship wgt 145 lbs per C Ultimate

IS THE ANSWER TO R.E.A. AND LIGHT TRANSMISSION LINE CLAMPS

Large legible blueprints covering a full line of accepted clamps and fittings — ultimate strength, weight and recommended conductors, together with all other specifications the engineer wants and understands.

Brewer-Titchener Corporation has always worked in close co-operation with the engineer, insulator and cable manufacturer.

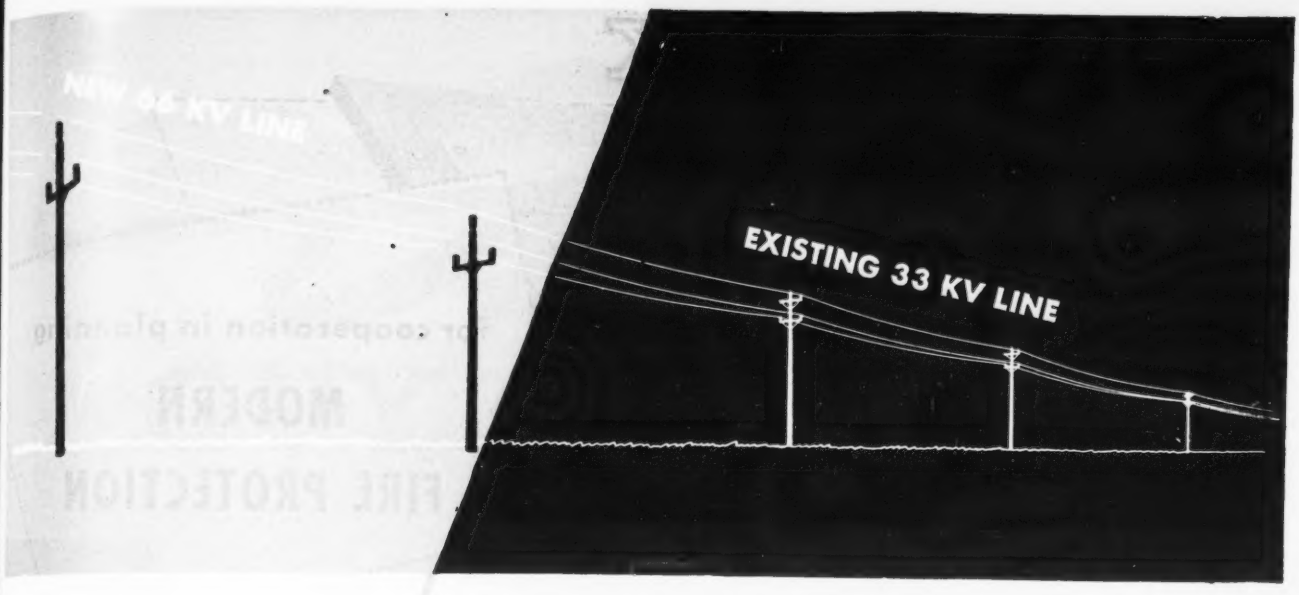
We believe you will find the resulting reference book invaluable in your planning. A copy is available upon request. Please mention Brewer-Titchener Corporation Hi-Line reference book.

Through Your Insulator Manufacturer Only

BTC

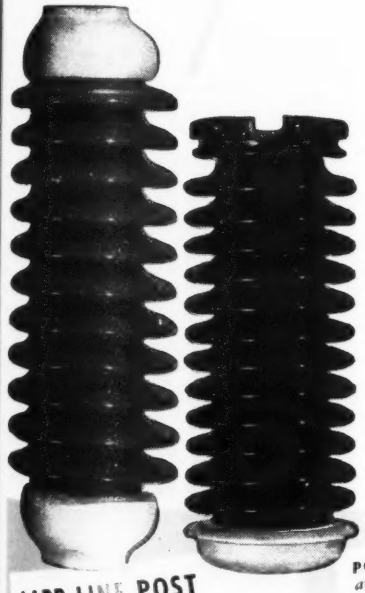
Transmission Line Hardware

THE BREWER-TITCHENER CORPORATION
CORTLAND, NEW YORK



is the fastest way to fortify your system . . . . and uses least materials

New or increased load demands frequently can most efficiently be handled by conversion of existing lines to higher voltage. For this job, Lapp Line Posts are particularly suited. Using present sound poles and conductors, conversion to higher voltages can be accomplished with no more than new cross-arms and Lapp Line Posts. Nor need such construction be considered as an emergency temporary expedient. Such a line approaches the current ideal for a new line; and your Lapp Posts can be expected to give trouble-free service for a longer period of years than you ever got from conventional insulators.



LAPP LINE POST and STATION POSTS on your system offer . .

POWER ARCOVER. *Flashover and leakage distances are not appreciably lowered by damage —even loss of several petticoats.*

NO PUNCTURE. *Puncture path in Lapp Post design is as great as flashover path. Insulator will flash over rather than puncture.*

NO CRACKING. *One piece post body, not subject to bursting from tension strains created by thermal changes in nested parts.*

RADIO INTERFERENCE. *By virtue of design factors alone, radio interference is permanently prevented at rated neutral voltage.*

NO CLEANING. *Fog-type design preserves uniform leakage path, prevents leakage flashover, makes the unit "self-cleaning."*

MECHANICAL RUGGEDNESS. *Stones or bullets deflect off, or rupture petticoats, leaving post body intact and insulator secure.*

Lapp

ARMY (E) NAVY

LAPP INSULATOR COMPANY, INC., LE ROY, N. Y.

LOOK TO CARDOX

Let CARDOX Engineers help you analyze the fire protection needs of your post-war plants and manufacturing processes. Whether the hazards call for a fixed system, mobile equipment, or a combination of the two, Cardox protection, engineered and planned for the specific hazards it covers, provides for quick extinguishment with minimum damage to buildings and their contents.

Advantages of Cardox Engineered Fire Protection

Through Cardox methods of control and engineered application, a Cardox System extinguishes fires and cools out fire zones and combustibles by *mass* discharge at high rate of flow of *pounds* or *tons* of non-damaging, non-contaminating Cardox CO_2. Control may be fully automatic, manual, or a combination of the two. Automatic systems include actuation by heat detectors, pre-discharge alarm, release of doors and windows, shut down of fans and motors and essential related functions.

Uniform, Enhanced Extinguishing Performance

Carbon dioxide, one of the fastest of all fire extinguishing mediums, is given uniform, enhanced performance by the Cardox method of control and application. For example, Cardox CO_2 has uniform extinguishing characteristics regardless of plant or atmospheric temperatures; its high CO_2 snow yield provides increased cooling effect (carbon dioxide released at 0°F. yields 45% CO_2 snow); and, because of high CO_2 snow yield and special engineering of Cardox nozzle, accurate projection is achieved through relatively great distances.

Write on business letterhead for Bulletin 525 containing interesting data on modern fire protection through engineered applications of Cardox Fire Extinguishing Systems and mobile equipment of special interest to architects.

●

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS
New York • Boston • Washington
Detroit • Cleveland • Atlanta • Pittsburgh
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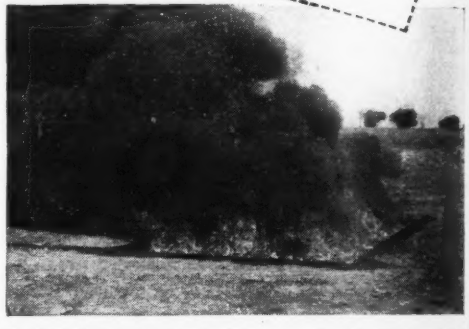
BUY WAR BONDS

CARDOX
CO_2 FIRE EXTINGUISHING SYSTEMS



In this demonstration of the speed and efficiency of a Cardox Fire Extinguishing System under extreme conditions, 100 gallons of quenching oil, primed with gasoline, was allowed to burn long enough to develop maximum burning rate and heat.

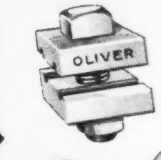
At the height of the burning period a mass discharge of Cardox CO_2 was applied from fixed linear nozzles on two sides of the 10′x20′ test pool. Note in picture above how the mass discharge of Cardox CO_2 is enveloping the fire zone.

Complete extinguishment and cooling below re-ignition temperature was accomplished in total discharge time of 33 seconds. Note CO_2 snow on oil surface.

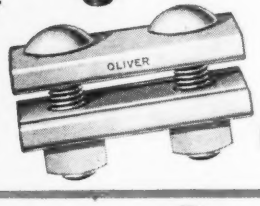
FROM THE COMPLETE LINE OF OLIVER POLE LINE MATERIALS

Oliver GUY CLAMPS

LIGHT TYPE



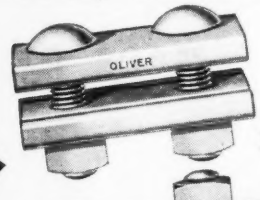
No. 8990



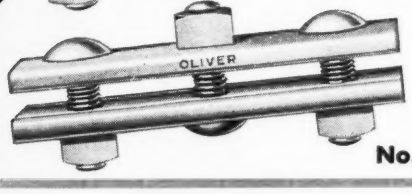
No. 9021

For 1/8 to 1/4 inch strands, Oliver Light type Guy Clamps are made in lengths up to 7 3/4 inches, with one to four bolts as required. Rigid manufacturing tolerances assure proper seating of guy strand, and maximum holding power.

MEDIUM TYPE



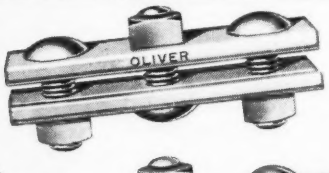
No. 9000



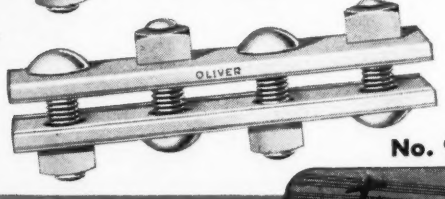
No. 9002

Used for strands up to 3/8 inch, Oliver Medium Guy Clamps are hot rolled from high quality steel, hot galvanized. High-strength, heat treated bolts have a shoulder to prevent turning when being tightened.

HEAVY TYPE



No. 9004



No. 9005

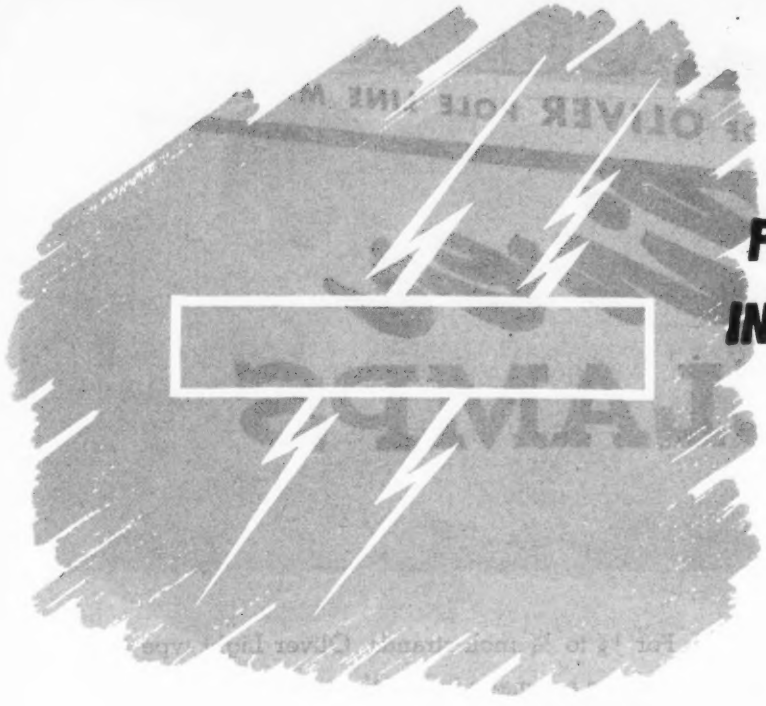
For strands up to 5/8 inch, Oliver Heavy type Guy Clamps use 2, 3 or 4 bolts, and are made in lengths up to 8 inches. The straight, smooth, parallel grooves of Oliver Guy Clamps provide greater clamping area and are not injurious to strands.

Write for the Oliver Catalog of Line Materials

OLIVER
IRON AND STEEL
CORPORATION

Makers of Pole Line Hardware since 1894

SOUTH TENTH AND MURIEL STREETS · PITTSBURGH 3, PENNSYLVANIA



FOR EXCELLENT PROPERTIES IN ELECTRICAL APPLICATIONS CONSIDER...

POLYTHENE

A NEW PLASTIC MADE BY DU PONT

POLYTHENE, a versatile new plastic, possesses outstanding electrical properties. Its unique combination of good electrical and mechanical properties, in conjunction with unusual chemical resistance and ease of working, has accounted for its immediate acceptance in the field of electrical insulation, particularly for high-frequency systems. Its dielectric constant (at 60 cycles, 2.2-2.3) and power factor (at 10^6 cycles, <0.0005) remain constant over a wide range of frequencies, and the dielectric constant changes very little over the temperature range from -50°F to 220°F.

Because of polythene's extremely low moisture-absorption (less than 0.005%), its electrical properties are practically unaffected by changes in humidity. It is not affected by long immersion in brine. Standard electrical-grade polythene to which an inhibitor has been added shows only slight change in tensile strength or elongation after exposure outdoors for six months. Because polythene resists battery acids, and has good impact strength, application in this field will show many advantages.

Polythene was originated by Imperial Chemical Industries, Ltd., in Great Britain, and has been developed and improved by Du Pont.

AVAILABILITY. Du Pont is now producing polythene for important war purposes. However, quantities up to twenty-five pounds can be secured for experimental purposes according to WPB Order M-300, Schedule 60. Write for properties chart and other data to E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, N. J.

DU PONT

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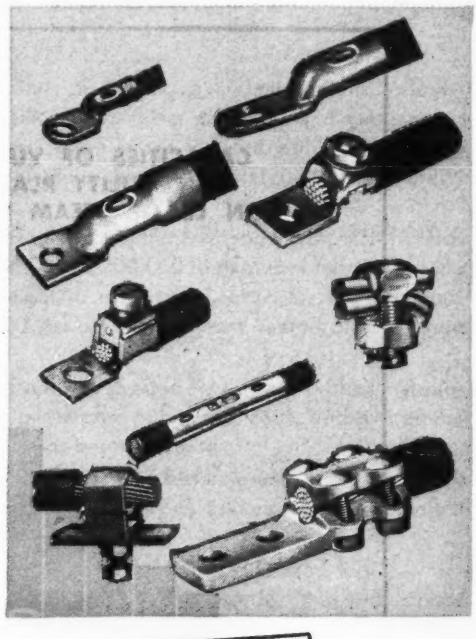


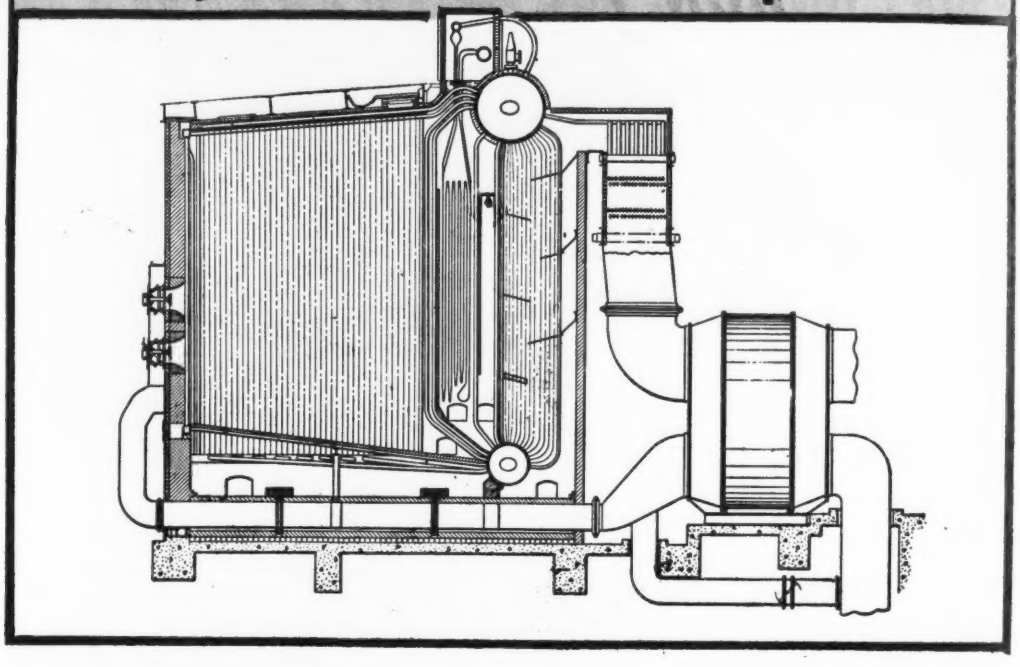
Headquarters for CONNECTORS

Burndy

In Canada: Canadian Line Materials, Limited, Toronto 13.

RANGE OF CAPACITIES, TEMPERATURES

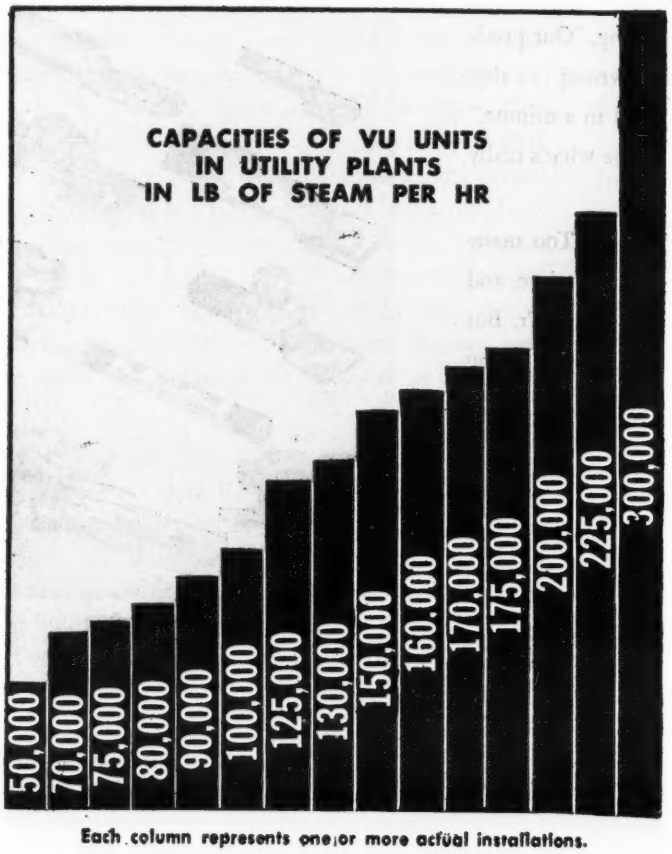
300,000 lb of steam per hr



Total steam temp.—905F

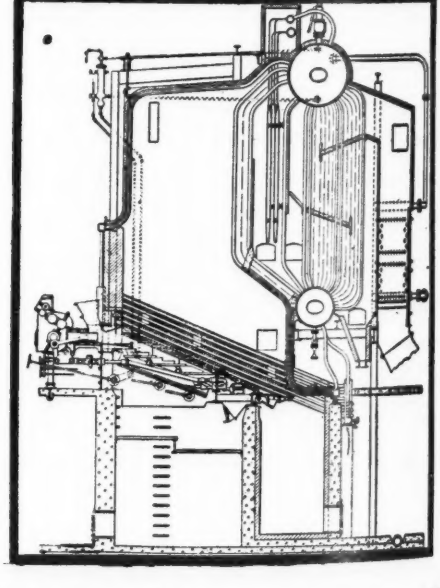
Design pressure—1000 psi

Oil Fired



Each column represents one or more actual installations.

70,000 lb of steam per hr



Total steam temp.—510F

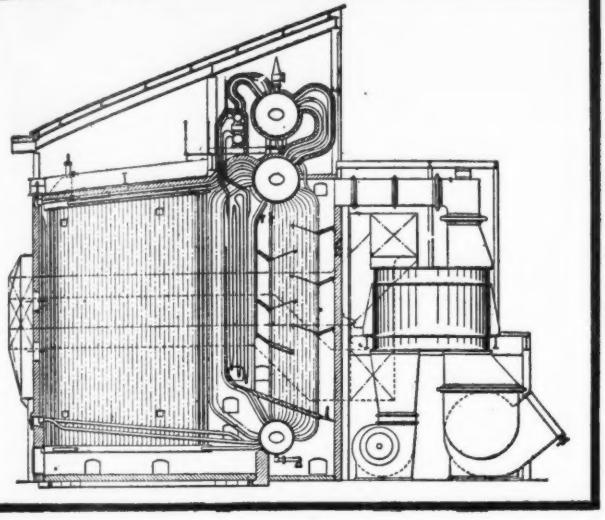
Design pressure—250 p

Multiple Retort Stoker

PRESSURES, AND VARIETY OF FUELS

emphasize adaptability of the VU UNIT to utility requirements

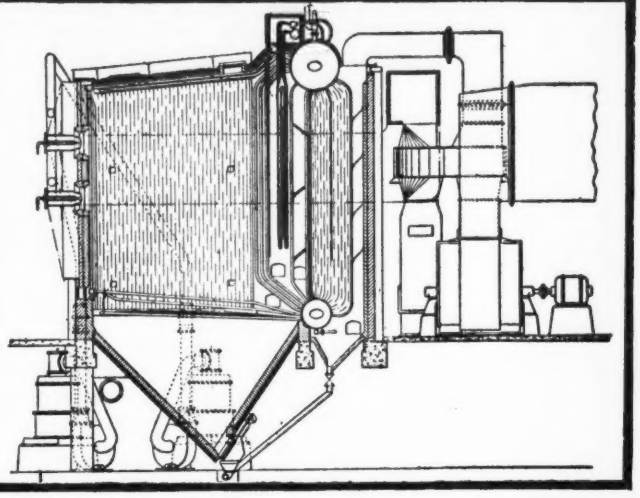
00,000 lb of steam per hr



otal steam temp.—760F Design pressure—525 psi

Natural Gas or Oil Fired

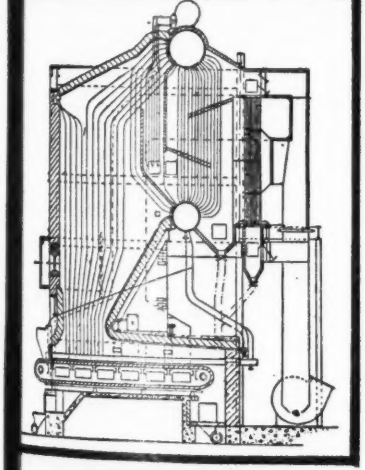
150,000 lb of steam per hr



Total steam temp.—689F Design pressure—300 psi

Pulverized Coal Fired

50,000 lb of steam per hr



Total steam temp.—650F
Design pressure—450 psi
Traveling Grate Stoker

The large number and great variety of existing utility installations, in terms of steam capacity, diversity of fuels and firing methods, and geographic distribution not only show the broad application of the VU Unit within its capacity range but also stress the endorsement given to this standardized design by utility engineers.

The capacity range is graphically presented on the left page with installations of 15 different sizes in the range from 50,000 to 300,000 lb of steam per hr showing how precisely the VU Unit can be brought to meet your particular requirements. Design pressures are from 250 to 1,000 psi and total steam temperatures range up to 905F

The variety of fuels which can be utilized is suggested by the five typical installations illustrated. They include oil firing, oil or gas, pulverized coal, and two of the four types of stokers to which the VU Unit has been adapted.

In the matter of geographic distribution the VU Unit has extended itself into every corner of the country, with utility installations in as many as nineteen of the forty-eight states.

The dependable performance of VU Units, which is re-emphasized today under the stress of wartime operation, accounts in large measure for this widespread acceptance by utility engineers.

A790-A

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Facts

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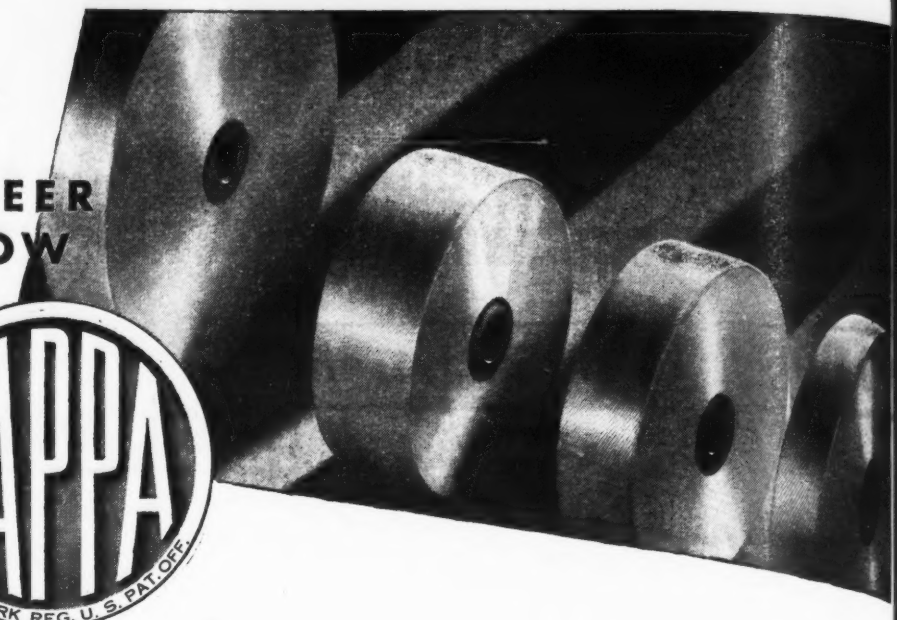
WOVEN CELLULOSE ACETATE RAYON



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LOW COST

Kappa Tape compares in cost with standard grades of organic insulation fabrics. It is substantially lower in cost than specifically purified materials. Yet Kappa Tape is a product of the very highest quality, measuring up to the most exacting specifications in every respect.

•

HIGH DIELECTRIC

Samples of varnished Kappa Tape tested against samples of standard coil winding tapes showed 1600 V P M with one mil varnish build-up as opposed to 600 V P M with four mils varnish on ordinary tape.

•

LOW MOISTURE ABSORPTION

Kappa Tape samples show a moisture regain less than ½ that of cotton and ⅓ that of silk.

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RESISTANCE TO AGING

Varnish impregnated samples of Kappa, tested under accelerated aging conditions, showed results indicative of two to three times longer normal service life than could be expected with ordinary organic woven materials.

SPACE SAVING

Equally high dielectric with less varnish build-up permits more compact windings. Kappa tapes wind smoothly and evenly, help eliminate entrapped air pockets, make compact, uniform windings with maximum electrical efficiency in minimum space.

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VARNISH ECONOMY

Kappa Tape users have found, in many cases, that the same high dielectric and fine quality of finish can be obtained with fewer varnish dips and less varnish, due to the excellent varnishing qualities of Kappa material... its smooth, uniform texture and freedom from lint.

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AVAILABILITY

Kappa Tape is readily available in standard widths and consistent mil thicknesses... also in special widths. Write us for Kappa Technical Bulletin containing detailed test data; also for long length samples for your own tests.

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KAPPA

Seyler

for

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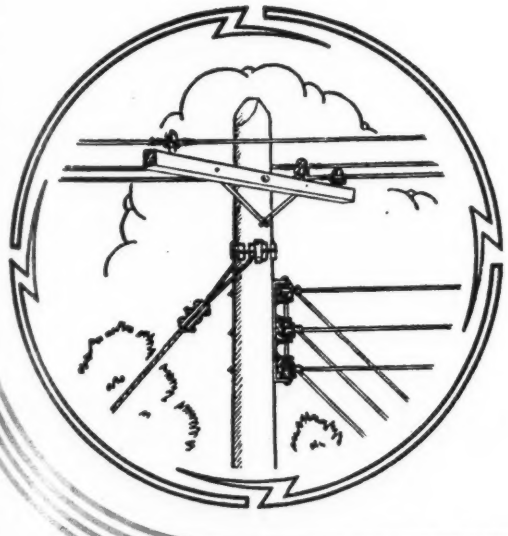
This *uninterrupted production of pole line hardware* assures you of an adequate and experienced source of supply at whatever time you call upon us.

To help you plan for the line construction work ahead and to assist you in rebuilding inventories we suggest that you send for Seyler Catalog No. 43. You will find it a useful manual for both your design engineers and purchasing department.

Seyler Catalog No. 43 contains detailed line drawings for each product. Hardware for both wood and steel construction is included. There is both a stock number index and an index arranged alphabetically by product.

Our engineering department, our sales engineers and our distribution channels are ready to help you.



SEYLER
MANUFACTURING COMPANY
BOX 7827, SHARPSBURG P. O.
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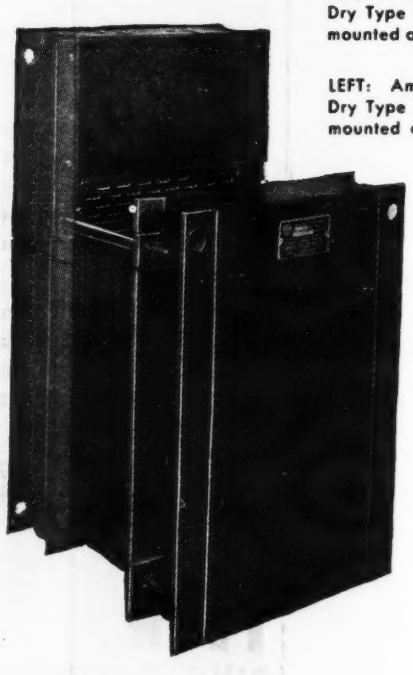
STOP MOTOR STARVATION

WITH AMERTRAN DRY-TYPE TRANSFORMERS AT LOAD CENTERS

ABOVE: AmerTran CF Dry Type Transformer mounted on an I Beam

LEFT: AmerTran WF Dry Type Transformer mounted on pillar



When motor relays kick out, overload is not always the cause. Such motors may be underpowered because long secondary feeders or other load centers have robbed them. Yet these outages can be corrected or forestalled and substantial copper savings effected—by stabilizing load center power distribution with AmerTran Dry-Type Transformers.

No disturbance of existing equipment is necessary. Eye beams or pillars close to the work can furnish mounting because AmerTran Dry-Type Transformers are unusually small and light for their conservative ratings. Comprising both standard and special types, they are available in a wide range of ratings and for many applications. If desired, Class B insulation may be specified. Write today for descriptive literature.

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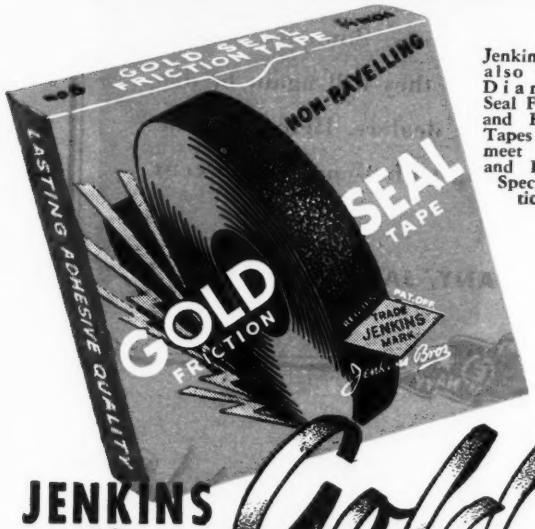

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Matter of fact – and in all seriousness – you'll probably *never* run into a roll of Jenkins Gold Seal Tape that peels... dries out . . . smears your hands . . . ravels . . . or lacks the right amount of tack.

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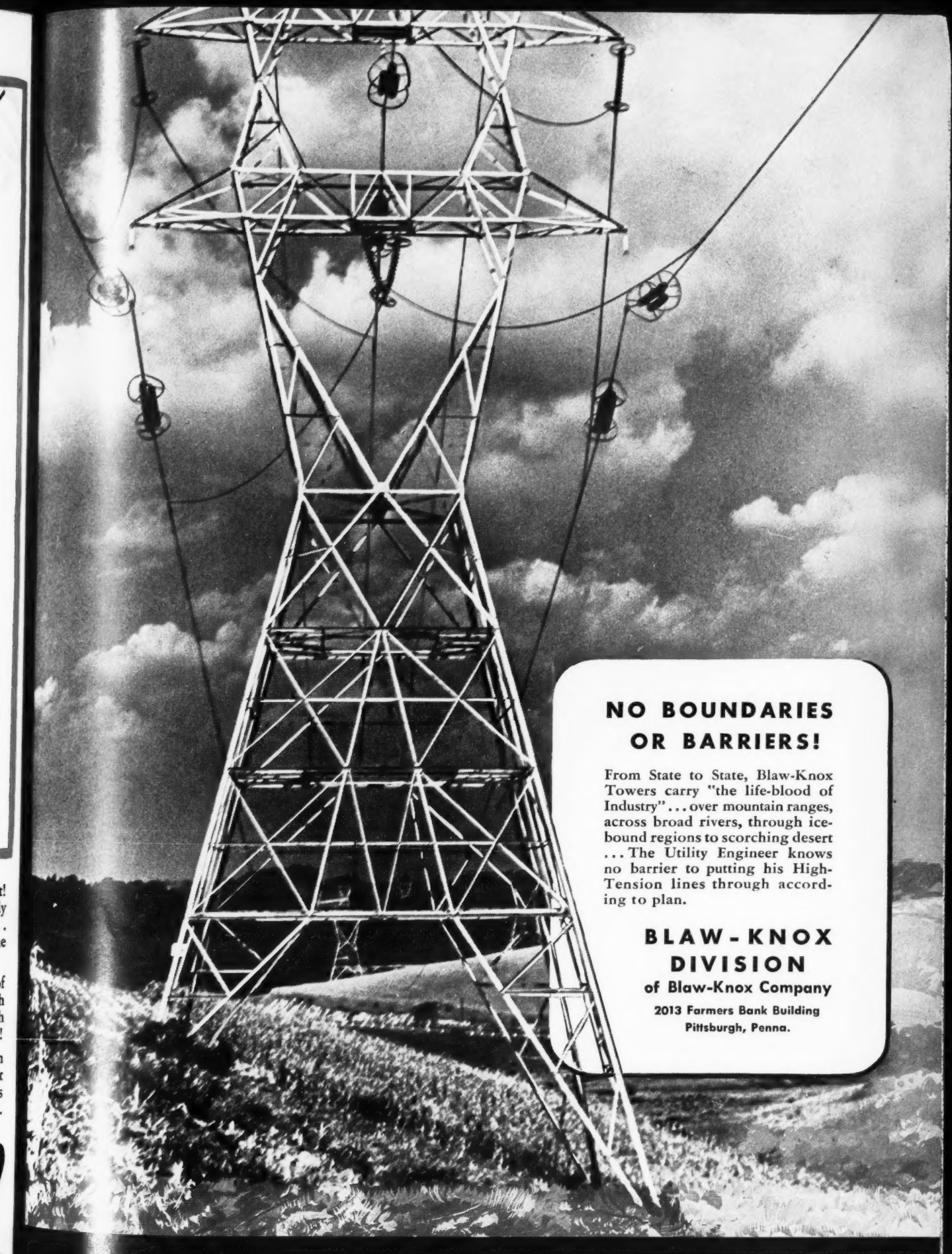

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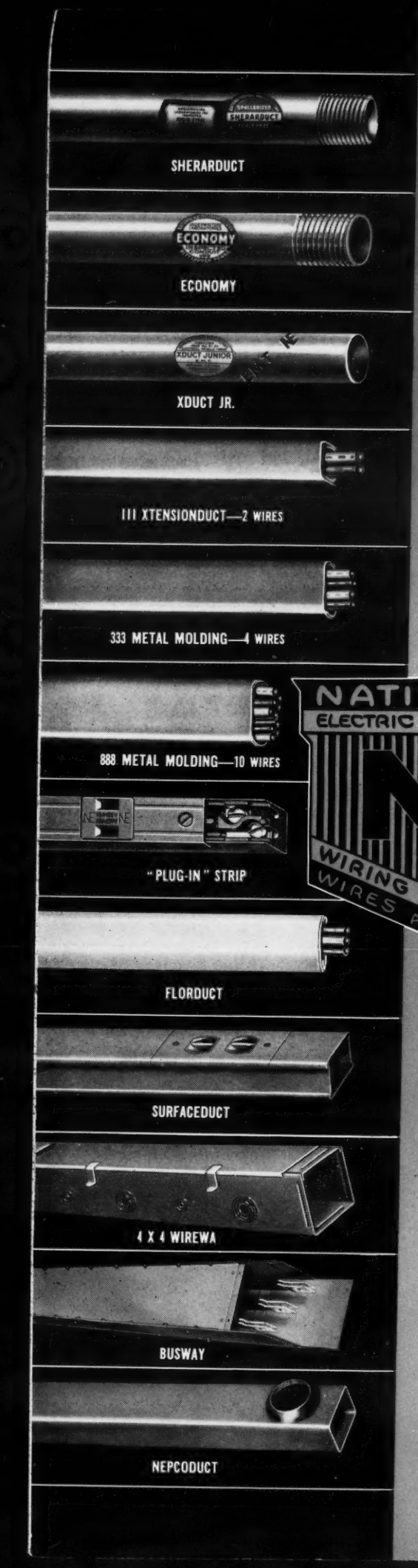

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Pittsburgh, Pa.

Electrical World
FEBRUARY 17, 1945

Valley Projects

NOT RIGHT AWAY, maybe not this year, but before the fourth term is too far spent, legislation for the creation of additional valley authorities will again come before Congress. That the development of a watershed by a multi-purpose project produces benefits for the people in the area can hardly be disputed in the light of past experience with both TVA and Bonneville. In fact, if it were not for the constant threat of loss of territory it might be said that the federal power competition was not without value to utilities, for it has resulted rather generally in a more aggressive load development program. And even where the competition has brought very low rates in its wake, there is as yet no indication that they have proven ruinous, even with high taxes.

So far the industry has opposed the creation of these valley authorities on the ground that there was no need for them. Maybe after the war loads have disappeared it will develop that there will be more power available than the area can immediately absorb. If that happens it will be far better to be concerned with finding out how that surplus can be marketed quickly than to sit back and say, "I told you so."

These valley projects are going forward and, since they are too big and present no apparent market initially, private capital must give way to government financing. And if private capital cannot do these things it cannot expect the people who anticipate benefits from a project to be very sympathetic to the attacks on it.

It should be clear to the industry by this time that these valley authorities are here to stay. They have made great inroads into private domain and will continue to expand by acquisition of territory just so long as they cannot market their outputs any other way. The most elementary thinking, then, would seem to indicate that the successful utilities will be those who help these projects to move their power.

In some areas, forward-looking operators are planning on exactly that procedure. They are likely to have far less difficulty with their federal competition than operators who employ different tactics.

Of course, it is not always as easily done as said. When the local authorities are not self-governing but must follow philosophies of anti-utility Washington officials, it is not easy to cooperate. On the other hand, autonomous valley authorities should present an entirely different situation because they want to live in peace in their area.

It need not be thought, however, that an independent authority will be easy to handle. It will be just as firm and just as hard a bargainer, but it will bargain. Under such circumstances, business men can come to an agreement that is mutually beneficial.

There is only one caution for anyone who can see an out through teamwork. The utility executives must be able to match in vision the expectations of both the authority administrator and the people of the valley. The load-building thinking of many non-competitive areas will not be big enough.

Hydro Project Solves Uruguay's War Fuel Crisis

Rincon del Bonete hydro project on Uruguay's Rio Negro, is being completed to curtail use of cereal grain as emergency fuel for power. Two of four hydro units, 145-mile transmission line, transformers and switchgear involved initially

LUIS GIORGI, Montevideo, Uruguay, S.A., and L. F. HARZA†, Chicago, Ill.*

CORN, SUNFLOWER SEED and other grain has, since the outset of the war, been the principal fuel burned in Uruguay's two main generating stations at Montevideo. These emergency fuels, plus what little coal is available from England, as return cargo, have largely been the only ones obtainable to this South American republic; a prairie country without native fuel resources either liquid or solid.

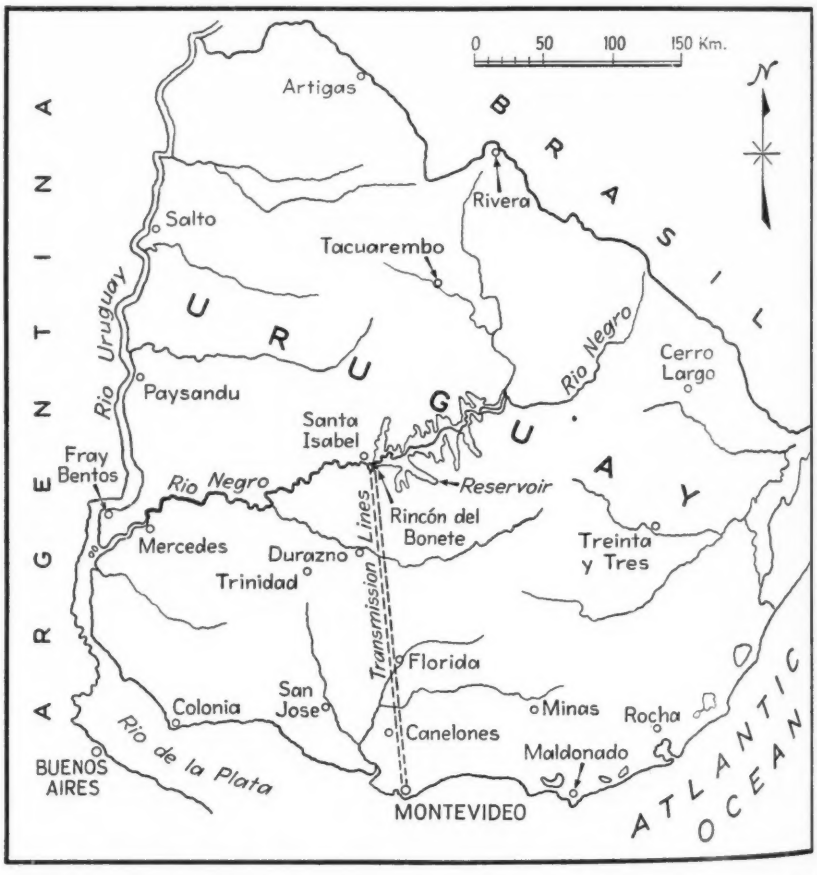
Such economic waste was the more appalling since relief from the republic's first hydro-electric development, the 128,000 kw. (ult.) Rincon del Bonete project on the Rio Negro, lay almost within reach.

Initial Construction

Construction on this project was started in the spring of 1937 by a German syndicate and reached the stage where the dam and power house substructure were nearly completed when work was stopped by the war in July, 1942. Machinery, largely if not completely finished, tested and accepted, was in Germany awaiting shipment. Only embedded parts of the turbine, such as draft tubes, speed rings, scroll cases, pit liners, steel penstocks and intake gates had been shipped and installed. The rest of the turbines and all electrical equipment was still in Germany when war broke out, preventing delivery.

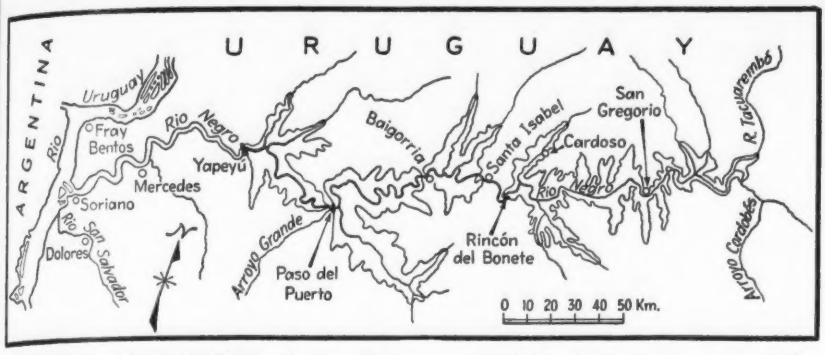
To relieve the power situation the Uruguayan government, in 1942, arranged with the U. S. Export-Import Bank for a loan of $12,000,000 to repurchase the necessary hydro-machinery, electrical transmission and transformation apparatus from U. S. manufacturers. Only one of the four ultimate 32,000-kva. turbo-generators and one of two 145-mile, 161-kv. transmission lines and related equipment were to be supplied during the war; the remainder to come after the war. This limitation has since been relaxed and material for a second unit has been released by the War Production Board.

The first unit, scheduled for oper-



RINCON DEL BONETE hydro project on Rio Negro will supply power to Montevideo, capital city of Uruguay 145 miles distant, over two 161-kv. steel tower transmission lines. Two of four 32,000-kva. units and one transmission line have been authorized initially for this project

* Director General—"Comision Technica y Financiera de las Obros Hidroelectricas del Rio Negro," (Rione)
† President, Harza Engineering Co., Chicago



EVENTUAL DEVELOPMENT of Rio Negro contemplates four power sites with a capacity of 458,000 kw. Rincon del Bonete reservoir is the upper one on the river from which water will be released to downstream projects

ation in 1945, will eliminate about 70 percent of the consumption of cereals for fuel in Montevideo steam stations. It will also afford an opportunity for retiring long fully loaded steam generating equipment for overdue maintenance, and so guard against possible collapse of Montevideo's electrical service.

The Electrical Market

Present consumption of energy in the interconnected system within a radius of 80 miles of Montevideo, which will be served by the Rincon del Bonete project, is about 300 million kw.-hr. per year. This is now generated by 90,000 kw. of steam capacity in the capital. Population of Uruguay is less than 3,000,000; Montevideo, 800,000.

Consumption is expected to increase to about 530 million kw.-hr. in 1951 when the 128,000-kw. Rincon del Bonete development, located near the geographical center of Uruguay about 145 miles from Montevideo is completed. At that time it is expected that about 90 percent of this energy will be produced by hydro and 10 percent steam facilities. The present consumption of energy in Uruguay is about 150 kw.-hr. per year per capita. This contrasts with about 1,100 kw.-hr. per inhabitant in the United States in 1940.

The Rio Negro, which is comparable in size with U. S. streams such as the Santee and the Susquehanna, flows entirely across Uruguay from the Brazilian border on the northeast, southwesterly into the Rio Uruguay. At Rincon del Bonete it has a drainage area of 14,600 square miles. Its slope from the head of the Rincon del Bonete reservoir to the Rio Uruguay is only 0.76 ft. per mile. Average annual rainfall on the river's total drainage area of 26,400 square miles in 45.4 in. per year, but is subject to erratic fluctuations and periodic severe droughts. For this reason storage of water is of great value.

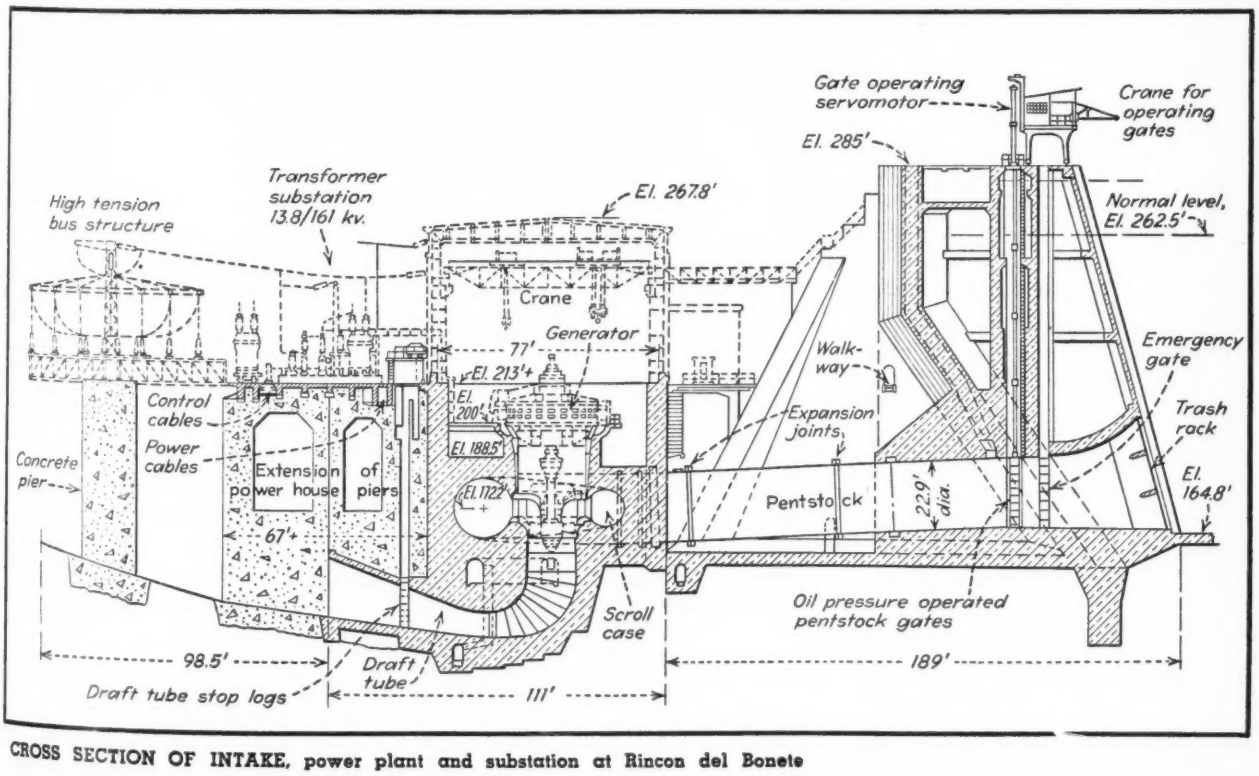
Initial Project

The Rincon del Bonete is one of four possible stations which may ultimately be built on the Rio Negro, as follows:

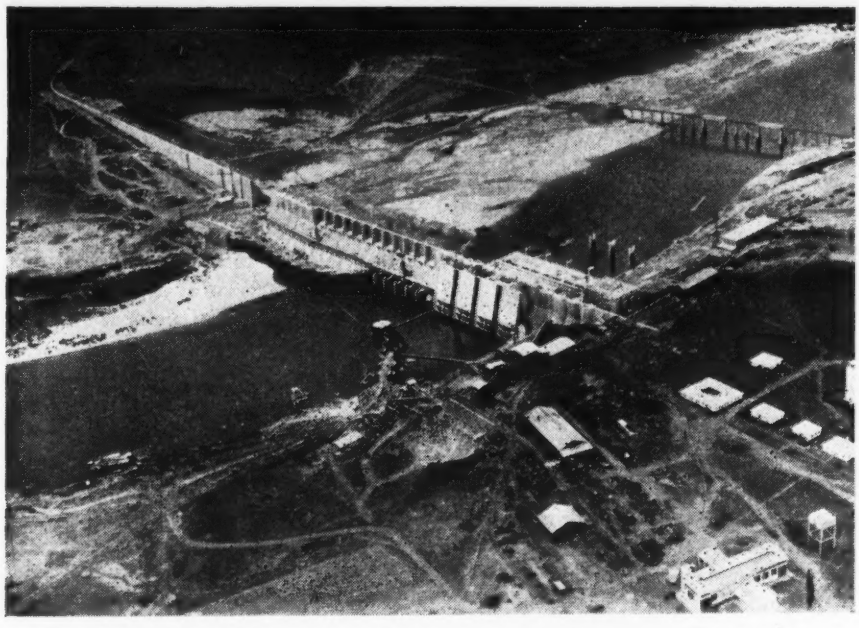
Name	Distance from River Mouth-miles	Approximate Installation-kw.
Rincon del Bonete...	245	128,000
Baigorria	192	84,000
Paso del Puerto.....	128	139,000
Yapeyu	84	107,000

The present project, the upper one on the river, is very fortunate in creating a large storage reservoir, release from which will be available to the other three projects when they are constructed.

Full economic values of the Rincon project cannot be realized until such utilization of its storage is complete. The reservoir will have a surface area of 443 square miles and a storage capacity, ignoring evaporation, of



CROSS SECTION OF INTAKE, power plant and substation at Rincon del Bonete



AERIAL VIEW OF DAM and powerhouse at Rincon del Bonete. Wheel pits and substation platform at power house are visible in foreground also piles to support bus structure and first tower for the transmission line

4,860,000 acre-feet in the 28-ft. intended drawdown.

Early Studies

The Uruguayan engineer Victor Sudriers began the study of the Rio Negro in 1904. Almost continuous efforts have been made to promote the development since 1909. In 1929-1930 the Uruguayan government employed Prof. Adolpho Lundin of Germany to prepare the final studies and general plans upon which the project was based.

Three world-wide efforts were made to obtain proposals on the Lundin project, but it was not until December 1936 that an award was made to a syndicate of German engineers, equipment builders and Buenos Aires contractors.

The way in which payment was to be made under the proposal is unique. It required payment in Uruguayan pesos for material and labor originating in Uruguay, in agricultural products of Uruguay for electro-mechanical equipment originating in Germany, and in gold for materials which the Germans need to buy elsewhere.

As was previously stated, construction work was started by the German syndicate in the spring of 1937 and continued until interrupted in 1942 by the war. By that time the German firm had nearly completed the dam and power house substructure but the machinery, largely completed and accepted was in Germany and could not be delivered. Only embedded parts of the turbines were shipped and installed as the concrete structure was built.

Subsequent to termination of arrangements with the German syndicate in 1942 the Uruguayan Government obtained a loan from the U. S. Export-Import bank of $12,000,000 to repurchase the machinery in the United States.

German Design Departures

Only obvious differences to be observed in the field between the embedded parts of German manufacture and comparable U. S. equipment is the complete lining of the draft tube with steel plate from the turbine around the elbow, and then horizontally to the tail gates. This compares with lining only about two or three draft tube diameters in the straight vertical cone below the turbines, usually practiced in the United States.

Also instead of the usual short U. S. turbine pit liners the German pit liners are carried up in welded steel to generator floor level and adapted as bases for the generator. This is also done occasionally in the United States especially for high heads. Initial effective head at Rincon del Bonete is approximately 92 ft.

The diameter of base thus made available, and to which the U. S. generator had to be fitted, is greater than for standard U. S. design. This greater diameter increased the runaway speed problem for the generator designers but made it easier to accommodate a slower and more efficient operating speed of unit, with very little increased cost. The German speed of 136.4 r.p.m. was thus decreased to 125. This slower speed was preferred also by the German report on the project, but not adopted because of greater generator cost.

Electrical Features

The Rincon del Bonete station will ultimately contain four Kaplan-type adjustable-blade hydraulic turbines, each rated at 45,000 hp. and each driving a 32,000-kva., 13,800-volt, 50-cycle, 3-phase generator.

Energy will be stepped up to 161,000 volts by a substation mounted on a compact tailrace platform on nearby river piers, built for that purpose by the Germans and therefore utilized practically as designed by them. From this substation the energy will be transmitted to Montevideo, about 145 miles distant over hollow-type HH copper conductors on two (only one to be built now) single-circuit steel tower lines 100 meters (328.1 ft.) apart, except for 12 miles of double-circuit tower line in the environs of Montevideo where right-of-way is expensive.

With the elimination of aluminum by war restrictions, copper only was available and the type HH copper conductor of 296,000 circ:nail. was adopted for this project.

In spite of war restrictions, steel towers were authorized instead of wood poles because of the *absence* of timber for 65-ft. poles in South America, and the consequent need of shipping from the United States at the sacrifice of more cargo space than was needed for steel towers.

Montevideo Network

The line will be terminated at the North Substation located in the northern outskirts of Montevideo. Here the voltage will be stepped down to 31.5 kv. and distributed to load centers in Montevideo over a 31.5-kv. underground network. The main part of the network resembles a square with a diagonal connecting the north substation at one corner directly to the steam plant substation at the op-

posite or south corner. The other two corners represent substations, one in the east and the other in the west side of the city. The steam plant now serves these two substations through two sides of the square. Other sides of the square will serve to feed these substations by the hydro from the north substation. At the north and steam substations, and at east and west substations the voltage is again stepped down for distribution throughout the city over a 6.3-kv. underground network.

Use Air Blast Breakers

Air-blast circuit breakers on 31-kv. system were adopted in line with present trend to avoid the necessity for importing oil. This necessitated indoor location because the out-of-door type is not yet developed. At the north substation all switching is done on the low voltage side to get around lack of air-blast breaker in the 161-kv. class. Eventual resort to 161-kv. breakers will be necessary when more units are installed and space is being left for them.

lightning arresters are mounted on the transformer for purpose of maximum protection to same.

At the steam plant substation hydro power is paralleled with the steam plant rated at 90,000 kw. This rating has been considerably reduced during the last two years by deterioration of the power plant equipment due to the continued use of poor fuels, such as corn, sunflower seeds, Brazilian coal with 30 percent or more of ash, and other low grade fuels and inability to retire equipment long enough to make necessary repairs.

The machinery and equipment for the first hydro, transmission and transformation unit is nearing completion in the United States; closure of the dam is in progress, and operation is expected to commence sometime in 1945.

Hydro Features

The dam is 3,840 ft. long, all of concrete except 300 ft. of earth at the left end. Initial effective head will be about 92 ft., with provision for

VIEW looking at up-stream face of dam at Rincon del Bonete

Forced-oil cooled transformers are used at the hydro to cut down size and weight of units; critical material was thus cut to 60 percent.

Generating voltage of 13.8 kv. and two-winding transformers were adopted in preference to 6.6 kv. and three-winding transformers specified by the German firm. Local service is to be obtained by stepping down from the 13.8-kv. bus instead of from the extra transformer winding.

The transmission line is protected by double overhead ground wires, also by additional use of shielded wires on substation structures. The ultimate increase of about 10 ft. more.

Increased flow, created by release of water from Rincon, will provide a 7-ft. navigation draft for about 300 days per year from there to the mouth, a distance of 245 miles, and by means of a boat lift through the reservoir, another 93 miles.

A question may be raised by some readers as to the justification for the expenditure of materials and manpower during this critical war period. In explanation it should be said that Uruguay is a prairie state without any fuel of her own, not even timber and is dependent normally upon fuel oil from the Gulf in American tankers, not now available. Since the war began, the Montevideo steam stations, in common with those in Buenos Aires, have had only very restricted allotments of fuel oil and have been dependent largely upon corn, sunflower seeds and linseed oil (the latter only in Buenos Aires) together with such coal as is occasionally available to them.

One of the two large steam stations in Buenos Aires is burning enough wheat each day to feed all of Belgium and Holland and part of France, although Montevideo has depended upon corn rather than wheat. In view of such economic waste it seemed reasonable to expedite a hydro project so nearly completed.

U. S. Equipment

In the United States, S. Morgan Smith Co., are completing the first two hydraulic turbines to fit the embedded parts as already installed; the International General Electric Co., are supplying the generators, the Westinghouse Electric International Co., the transformers and switchgear for generating station and for sending and receiving substations, as well as transmission line insulators; the General Cable Corporation the transmission line hollow HH section conductors and the powerhouse and substation cables; the U. S. Steel Export Co., the transmission towers, powerhouse and switchyard steel, railroad rails, boat transfer car and miscellaneous steel.

The Harza Engineering Co., are completing the design of the project, the specifying and purchasing, inspection, expediting and shipping of equipment, and expect to have a representative in Uruguay during installation and initial operation. Ing. Luis Giorgi (Member, American Society Civil Engineers) of Montevideo is Director General of the project, Eduardo Terro-Arocena, Chairman of the Board, Ing. Victor Sudriers (Associate Member, American Society Civil Engineers), Vice-Chairman.

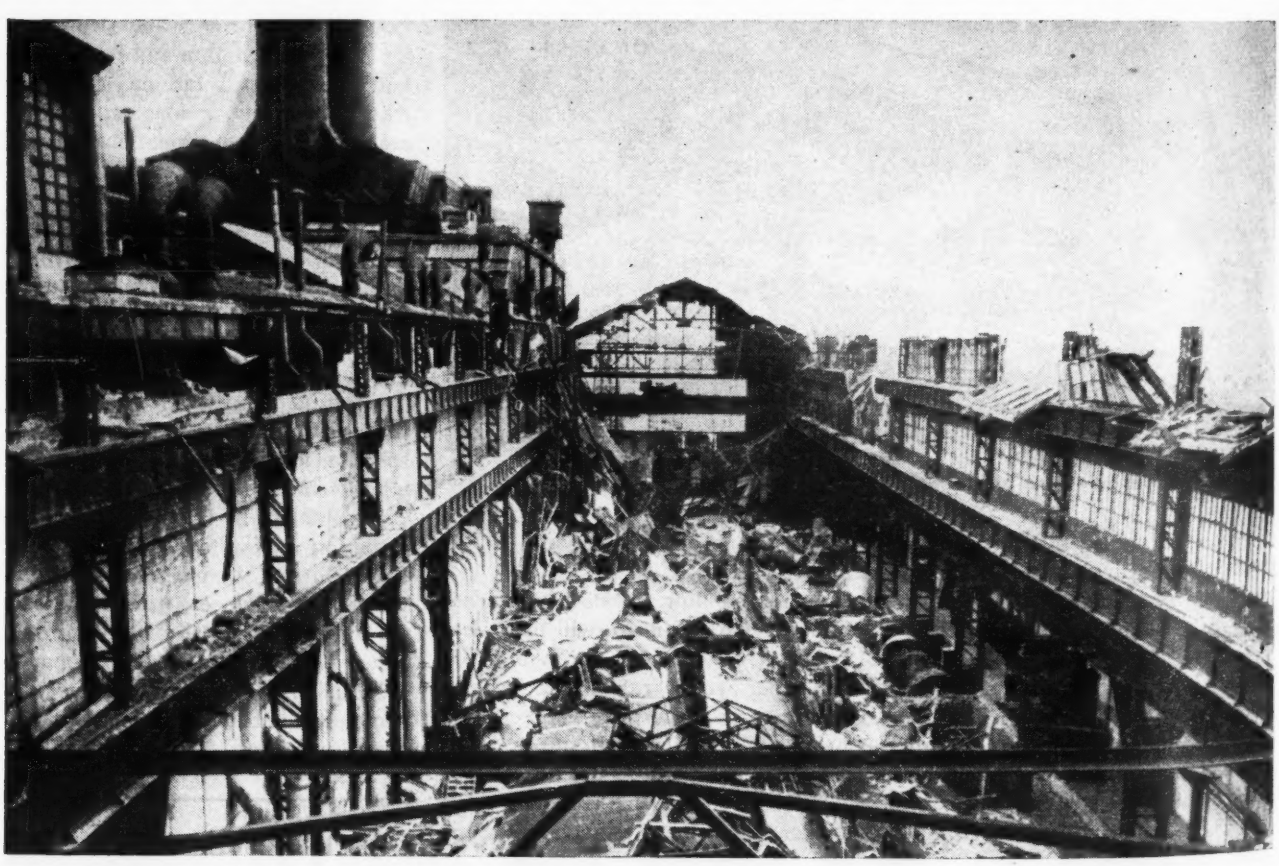
Be with your boy over there by giving over here to your RED CROSS

Valve Leakage Wrecks Steam Turbine in War Area

Operator in liberated area unable to close completely valves to base-load unit when interconnection inflow is interrupted and plant is overloaded—Cannibalization retrieves other units damaged by collapsing roof—Two cranes undamaged in turbine room

NOT ALL the problems of power plant restoration are caused by sabotage or by the tides of war flowing around generating stations. This was demonstrated last fall when a large station in a liberated area was thrown completely out of service for some weeks and was grievously damaged by the failure of three separate control devices which allowed a turbine to blow up and knock down the roof of the plant.

The train of events culminating in the explosion started when a system failure cut off imports which were carrying the major portion of the load served in part by the shattered plant. The resulting overload dropped frequency to about 43 cycles and brought about a wide variation in voltage. One of the plants was cleared by normal operation of the relay system. The station in question was left on the line with voltage variations surging as high as 15,000. Unable to control the single machine this plant had running on base load at the time, the switchboard operator cleared it from the bus by opening the generator oil circuit breaker. This acted to close



THIS GENERAL VIEW OF THE TURBINE ROOM was taken from the crane platform over unit No. 1. To the left is the boiler room, and to the right, the electric bay. Debris covering the units is the roof which collapsed when a section of the No. 6 turbine was blown through it. Coupling of the No. 6 turbine also was blown through the roof and came down through the roof of the auxiliary bus room, 150 ft. away. Salvaged and captured material utilized for temporary roof

the turbine admission valves, but not sufficiently to halt the machine. With the speed still increasing, the operator tried hand-operated valves corresponding to a U. S. throttle valve, used to bring the machine up to speed. These valves also are connected with a second over-speed trip, which failed to work either mechanically or by hand.

The Runaway

With another workman, the operator then tried to close the steam stop valve in the boiler room, but before this was accomplished, the machine ran completely out of control and blew up. The coupling was blown through the roof which, weakened by bombing when fighting was going on in the area, collapsed completely except for small sections at each end. The coupling came down through the roof of the auxiliary bus room, 150 ft. away. While the cranes, one at each end of the turbine room, were undamaged and their supporting structure was such as to allow their use despite the roof failure, considerable of the roof steelwork had to be cut free of the crane rails. All units on the floor were covered by steel and bricks. A temporary roof of wood poles and salvaged corrugated iron was erected to cover four converters and the d.c. switchboard. Other roof was fashioned from tar paper and chicken wire found in captured German stores.

Damaged Units

Damage to two units, each of 50,000-kw. capacity, was principally confined to piping, and each unit was expected to be back in operation in about two weeks if necessary. A third unit was completely out of service before the accident and was cannibalized to provide replacement parts for other machines. Two other units which were being used as synchronous condensers had their end bells badly damaged, but it was believed that they could be patched and welded. A 35,000-kw. machine sustained piping damage and serious damage to its governor mechanism, but it was hoped that it could be repaired by salvaged spare parts from other machines. The unit which blew up was destroyed completely. Another 50,000-kw. unit, sustained damage to its governor mechanism, and its upper right condenser connection was broken in so many places as to be useless. This happened when the stator of the generator on the blown-up machine was split longitudinally, flattened and landed upon the exhaust end of a neighboring unit.

GENERAL VIEW of unit No. 7 as seen from the turbine end of the machine. The debris is steelwork and roof topping in the area

Transmission Line Loading Charts

A series of three charts dealing with the loading of electrical transmission lines is reproduced in the discussion of the National Electrical Safety Code, Handbook H39. As they appear in the Handbook, these charts have been reduced to approximately one-third of their original size. Although it is possible to make reasonably accurate determinations from these small cuts, they are not satisfactory for regular use. Therefore, at the suggestion of several organizations and in compliance with requests from power and communication companies and from railroad signal engineers, it was decided to publish a set of full-size charts, and these are now available as Miscellaneous Publication M176. The use of these larger charts will permit rapid and accurate determination of values and should save time in laying out new lines or when increasing the number of conductors on existing poles or towers.

Chart 1 consists of two conductor loading nomographs from which, when the vertical and transverse wind loadings are given, the total conductor loading may be obtained. Chart 2 gives: (A) Bending moments due to wind on a pole; and (B) Ultimate resisting moments of wood poles. Chart 3 is the catenary curve giving values of the sag at points on the curve expressed in percent of the center sag.

Copies of M176 (the set of three charts) are obtainable from the Office Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Cable Wrap Overlay Shown by Photography*

Special camera assembly quickly indicates staggering of creepage path through butt joints of successive layers—Affords means of evaluating control in cable production, as well as giving indications of wrinkles, wax formation and studying failure factors

LOUIS MEYERHOFF and WILLIAM P. FOSTER,† General Cable Corp., Bayonne, N. J.

A NEW TOOL for examining the structure of paper cable insulation is a photographic means of recording overlays developed in the General Cable Research Laboratory. The method is useful in evaluating factory controls of tape overlays and in recording wrinkles in insulation and wax formation; it has also been used to some extent in studying cable failures.

Insulation of a modern paper insulated cable is built up of successive layers of paper tapes. Each tape is applied helically with a narrow helical channel, commonly called a butt space, between successive turns. Each successive tape is applied with its butt spaces at a predetermined distance away from the corresponding butt spaces of the preceding tape. This distance, in terms of the tape width, is termed the overlay of the tapes.

In general, the overlay should be such as to produce a satisfactory combination of a long creepage path and a minimum number of butt spaces lined up in any radius. Having determined the overlay which is expected to produce best results the next step is to adhere to it as uniformly as possible.

* Adapted from paper presented at recent meeting of EEI Transmission and Distribution Committee in Pittsburgh

† Assistant to Director and Research Engineer, respectively, High Voltage Research

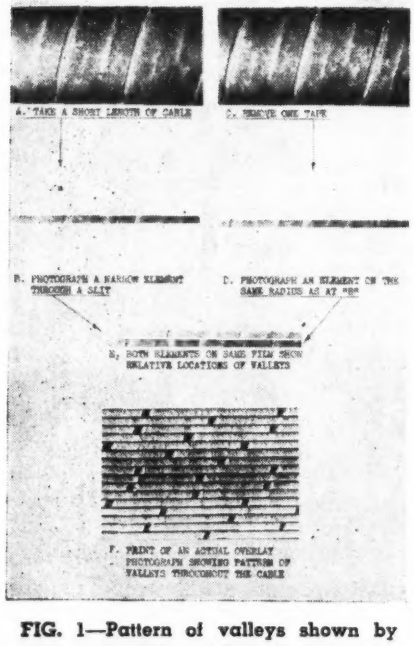

A. TAKE A SHORT LENGTH OF CABLE
C. REMOVE ONE TAPE
B. PHOTOGRAPH A NARROW ELEMENT THROUGH A SLIT
D. PHOTOGRAPH AN ELEMENT ON THE SAME RADIUS AS AT "B"
E. BOTH ELEMENTS ON SAME FILM SHOW RELATIVE LOCATIONS OF VALLEYS
F. PRINT OF AN ACTUAL OVERLAY PHOTOGRAPH SHOWING PATTERN OF VALLEYS THROUGHOUT THE CABLE

FIG. 1—Pattern of valleys shown by contiguous prints of butts for consecutive layers of tape

Photographic Procedure

It is, of course, highly important for the cable manufacturer to know how well his controls work out. For this purpose, as well as for correlation of structure with breakdown strength, it is our practice to examine carefully our cable insulation, especially after breakdown tests. An important part of the examination is the determination of overlays. Anyone who has made a complete cable dissection is well aware of what a laborious and time-consuming process it is to construct an overlay chart. In spite of the amount of time and work involved, however, the information obtained is so important that many such overlay charts have been constructed. Longitudinal styrene wafers have helped in reducing the amount of engineering time, but the elapsed time required to produce these make it impossible to have a prompt answer. Development of the new overlay photography affords a quick and accurate method of recording overlays.

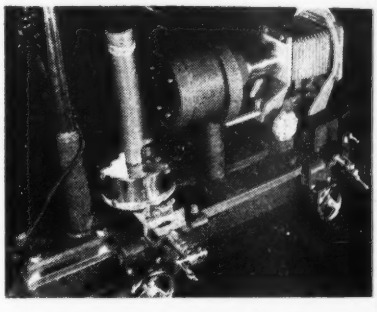


FIG. 2—Camera assembly for photographing cable wrap details

The time required for a complete overlay photograph (Fig. 1) will, of course, vary with the number of tapes on the cable, but on an ordinary cable about 20 minutes are required. The film must, of course, then be developed and printed in the usual manner. The result is that in a relatively short time there is provided a much more accurate record of overlays than is possible with the manual method in a much longer time. Study of the results is considerably enhanced by the use of enlarged prints.

The Overlay Camera

Photographs are taken by means of a specially constructed camera assembly (Fig. 2). If a spotlight be directed on a surface so that the light rays are nearly parallel to it, irregularities in the surface will cast shadows which will delineate the contour of the surface. On the surface

FIG. 3—Evidences of wrinkles show up as well as clearly defined butt spaces. Wrinkles may form when a tape draws down into a butt space from above while others are pressed up into it from below

of a paper cable, the most prominent irregularities are the butt spaces and wrinkles. Any other irregularities, such as tree designs and wax, which present a different shade to the camera, will also appear in a photograph. Thus, on a photograph of a sample illuminated as above described, all of the above listed effects may be observed if present.

In this special camera assembly the sample of cable is clamped in a modified lathe chuck which may be rotated so as to facilitate removal of tapes. An index is provided so that the chuck may be stopped at the same position after each tape is removed so as to insure that all the elements photographed are on the same radial plane. Horizontal and rotational adjustments are provided so that any required radial plane may be selected for analysis. The horizontal feed is useful when studying sector cables. There is also a hand feed on the carriage that supports the chuck for bringing the cable up to the slit for photographing and for drawing it back for ease in removing the tapes.

Photographs of the cable elements are taken through a slit in a plate at one end of a light-tight chamber. The lens in a drawn tube slides into a hole in the other end of the chamber. Beyond this is a bellows and the film holder. The slit and lens are centered on a vertical plane coinciding with the radial plane of the sample to be photographed.

The film holder is mounted on a carriage with a cross feed so that it may be moved in a direction perpendicular to the radial plane of the sample. The bellows permits this movement. The carriage may be moved parallel to the optical axis in order to give control of magnification and focus.

In the chamber just behind the slit there is a solenoid-operated shutter. This is controlled by an automatic timer which turns on the light and opens the shutter for a pre-set interval upon depressing a push button.

Photographic Procedure

To make an overlay photograph, the cable sample is mounted in the chuck and adjusted. The ground glass of the camera is next inserted and the lens is focussed, with the sample

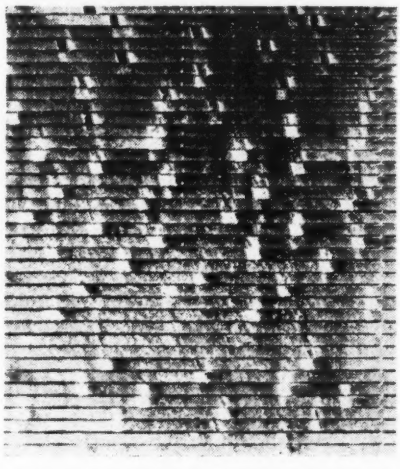


FIG. 4—Prevalence of wax also shows up in overlay print

touching an abutment in front of the slit plate. The film holder is then moved by means of the cross feed so that the first exposure will be at an extreme edge of the film. This feed is equipped with a ratchet device designed to move the film holder a fixed short distance with each operation of the lever.

A film is loaded into the camera and, with the sample touching the abutment, the first exposure is made. The procedure for each succeeding tape is to operate the feed ratchet, move the sample holder away from the slit plate, remove a tape, bring the sample back against the abutment and press the button.

Use of Overlay Photography

Primary purpose of the overlay photograph is the recording of overlays. However, it also serves other important purposes. Indication of wrinkles is one of these (Fig. 3). Another is the differentiation of low density from higher density papers. Thus, if the saturant is partially extracted from the sample, the higher density paper will retain more of the saturant than will the lower density paper and the two kinds of paper will appear in different shades, as may be seen in the slide.

Wax Formation

Wax formation, which is present in some cables after subjection to high voltage, also shows up in the overlay photograph, particularly if the saturant is extracted from the sample. Fig. 4 is an overlay photograph of a sample purposely selected because it has an exceptional amount of wax. The tapes nearest the conductor, being at highest stress, show the most wax. In some places the wax fills the entire butt space. In others there is wax opposite the butt space of an adjacent tape. In the ordinary case of a cable which has been under test, wax, if present, appears in much smaller quantities than in the figure, being usually confined to the butt spaces.

To a limited extent overlay photographs have also been used to study the progress of failures (Fig. 5). For more effective recording of failures by this means it may be necessary to re-orient the sample from time to time so as to bring the puncture within the range of the camera.

FIG. 5—Each strip in this puncture record is a portion of a surface. The composite is not a cross-section, hence the apparent discontinuities in the failure path. Evidences of coring and tracking (as described by Robinson) can be seen

Compare Impulse Characteristics-Protective, Protected Devices*

Comparison of impulse characteristics of distribution pole top devices with those of arresters and protector tubes reveals most suitable protective device for each class of application

H. F. OSTMAN,† Union Electric Co. of Missouri, St. Louis, Mo.

COMPARISON of the impulse characteristics of insulators and switches with those of lightning arresters and protector tubes, undertaken as a result of numerous insulator failures on 34.5-kv. circuits of the Union Electric system during the 1942 lightning season at locations where lightning protection appeared to be adequate, confirms the following three general principles, which are not new, but which it is believed did not receive sufficient consideration in our distribution design.

1. Impulse characteristics of all components of line construction and their assembly must be carefully checked and coordinated to achieve effective results in serviceability and economy.

2. Impulse characteristics of valve-type lightning arresters, protector tubes, and plain gaps differ substantially. They are not alternate interchangeable devices, but each is most effective for certain particular applications. For each class of application, therefore, the impulse characteristics of the equipment to be protected and of the protective devices must be carefully compared to determine the most suitable protective device.

3. In comparing the impulse characteristics of equipment protective devices and clearances, attention must be given not only to the crest values, but also to the shape and length of surges with particular reference to "steep front" waves and "long tailed" waves.

Specific Conclusions

Application of these three general principles to specific items of equipment leads to the following conclusions:

1. Protector tubes in general are effective for protection on porcelain and wood line insulation such as overhead switches and insulators, which have impulse characteristics similar to the tubes.

2. Protector tubes are satisfactory for distribution transformers having windings designed for their use and may provide effective protection for other distribution transformers of the 5-kv. class built since 1932.

3. Lightning arresters of the valve type are preferable for protection of other apparatus, including potheads.

4. Lead lengths between protective and protected equipment should preferably not exceed

6 ft. for 4.16-kv. apparatus
10 ft. for 13.8 -kv. apparatus
15 ft. for 34.5 -kv. apparatus

5. The margin between the 100 percent 13.2-kv. arrester and fibrous insulation as used in transformers and similar apparatus is too narrow. The 80 percent arrester is recommended for the Union Electric System even though some additional arrester failures may result.

6. It is believed that the insulator failures which lead to this study were caused by long-tailed surges, for which tubes alone furnish little protection in the 34.5-kv. class.

7. For protection of insulators in the 34.5-kv. class against long-tailed surges, at least 12 in. of wood must be provided in the ground circuit of the insulators to be protected, in addition to the proper protector tube application.

Flashover Characteristics

Volt-time curves are essentially graphs of the average values at which a particular piece of equipment will flashover when subjected to impulse waves of a stipulated shape. The 1½ by 40-microsecond wave is standard for this work. It means that an impulse reaches peak in 1½ microseconds and diminishes to half of the peak value in 40 microseconds.

Volt-time curves based on a 1½ by 40 wave, for each piece of equipment studied are shown, grouped by three voltage classification; 4.16 kv., 13.8 kv. and 34.5 kv. Relationships between protected and protecting equipment is summarized for each voltage classification and a value termed the "net protective margin" arrived at for the item under study when subjected to steep-front as well as long-tailed lightning surges. These results are shown in the three accompanying tables for some typical distribution equipment.

Volt-time curves used herein are partially from manufacturers' data and partially calculated. Where complete data is not available only the available portion of the curve is plotted, as in the case of potheads and certain specific dropout fuses.

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* Based on the paper "Impulse Insulation Levels—Distribution Equipment" presented by the author before the E.E.I. Transmission and Distribution Committee, February 17, 1945.

† Distribution Engineer, System Distribution Engineering Dept.

Since the breakdown values for all arresters and tubes vary, tolerances must be allowed. Published as well as verbal figures from manufacturers indicate plus or minus 25 percent as the working tolerance for front-of-wave breakdown for both arresters and tubes, with 20 percent for arresters and 25 percent for tubes on tail of the wave breakdown, respectively. In the case of tubes this includes a factor for variations in the external gap. Likewise, apparatus will vary as to the actual point at which spillover occurs. The measure of security on this score is shown in columns headed "net protective margin" in Tables I, II and III.

To secure a common base for front-of-wave flashovers of equipment a wave rising at 1,000 kv. per microsecond has been used, since it has become a standard with many designers for line insulation calculations. It should be kept in mind, however, that lightning surges follow no definite pattern in this regard and a wide variety in rates of rise will actually be experienced.

In the lower voltage lines as 4.16 kv. a wave rising at 1,000 kv. per micro-second may appear unduly severe. However, lightning surges with such steep fronts strike low voltage lines as well as the higher rated circuits, and it is thought more consistent to use the same basis of comparison throughout. It is further to be noted that all volt-time curves are based on direct line-to-ground path for the surge without any wood in the circuit. To illustrate the effect of wood, each drawing includes a curve showing the line insulator now in use for the voltage class in question plus 12 in. of wood crossarm. This is a calculated curve in each instance.

The tabular data has been kept as simple as possible by limiting the comparison strictly to the wave shape and rate of rise shown. Numerous

INSULATION COORDINATION CHARTS give volt-time breakdown characteristics of three voltage classifications of distribution equipment; Chart "A" for 4.16 kv., Chart "B" for 13.2 kv. and Chart "C" for 34.5 kv. Breakdown values shown in accompanying tables were taken from these curves

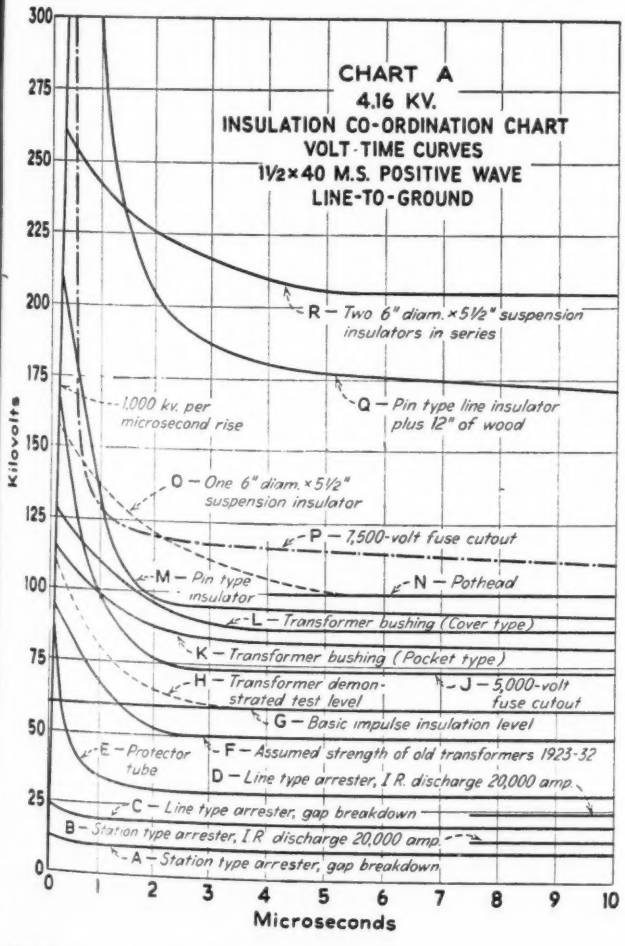


CHART A
4.16 KV.
INSULATION CO-ORDINATION CHART
VOLT-TIME CURVES
1½×40 M.S. POSITIVE WAVE
LINE-TO-GROUND
Kilovolts
Microseconds
R – Two 6" diam. × 5½" suspension insulators in series
1,000 kv. per microsecond rise
Q – Pin type line insulator plus 12" of wood
O – One 6" diam. × 5½" suspension insulator
P – 7,500-volt fuse cutout
M – Pin type insulator
N – Pothead
L – Transformer bushing (Cover type)
K – Transformer bushing (Pocket type)
H – Transformer demonstrated test level
J – 5,000-volt fuse cutout
G – Basic impulse insulation level
E – Protector tube
F – Assumed strength of old transformers 1923-32
D – Line type arrester, I.R. discharge 20,000 amp.
C – Line type arrester, gap breakdown
B – Station type arrester, I.R. discharge 20,000 amp.
A – Station type arrester, gap breakdown

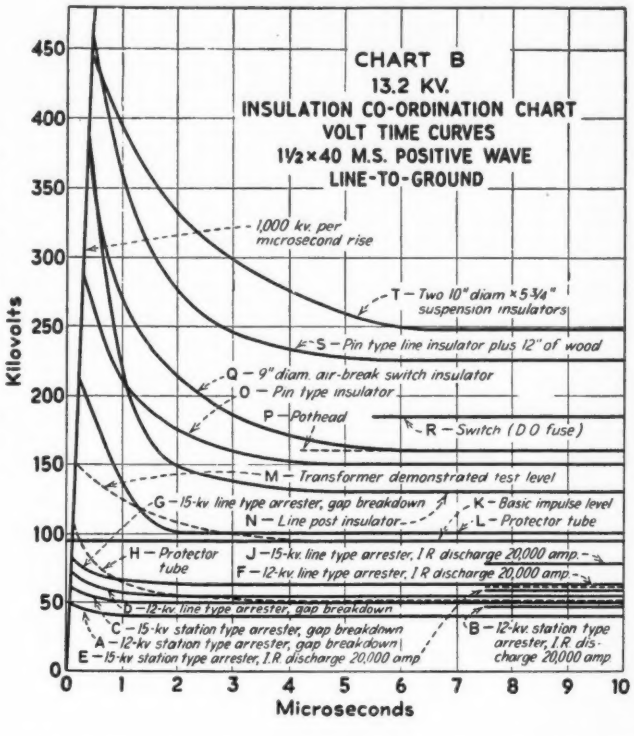


CHART B
13.2 KV.
INSULATION CO-ORDINATION CHART
VOLT TIME CURVES
1½×40 M.S. POSITIVE WAVE
LINE-TO-GROUND
Kilovolts
Microseconds
1,000 kv. per microsecond rise
T – Two 10" diam × 5¾" suspension insulators
S – Pin type line insulator plus 12" of wood
Q – 9" diam. air-break switch insulator
O – Pin type insulator
P – Pothead
R – Switch (D O fuse)
M – Transformer demonstrated test level
G – 15-kv line type arrester, gap breakdown
K – Basic impulse level
N – Line post insulator
L – Protector tube
H – Protector tube
J – 15-kv line type arrester, I R discharge 20,000 amp.
F – 12-kv line type arrester, I R discharge 20,000 amp.
D – 12-kv line type arrester, gap breakdown
C – 15-kv station type arrester, gap breakdown
A – 12-kv station type arrester, gap breakdown
E – 15-kv station type arrester, I.R. discharge 20,000 amp
B – 12-kv station type arrester, I.R. discharge 20,000 amp

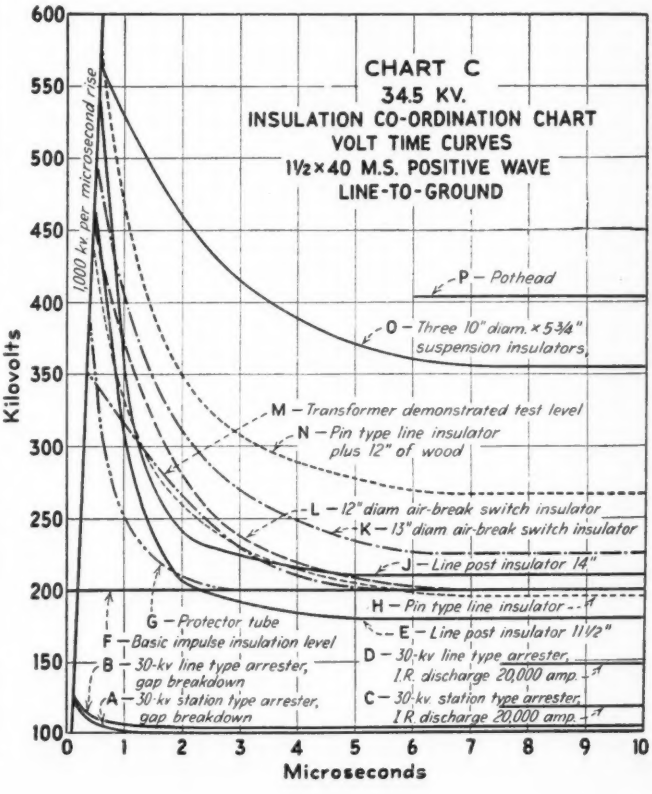


CHART C
34.5 KV.
INSULATION CO-ORDINATION CHART
VOLT TIME CURVES
1½×40 M.S. POSITIVE WAVE
LINE-TO-GROUND
1,000 kv. per microsecond rise
Kilovolts
Microseconds
P – Pothead
O – Three 10" diam. × 5¾" suspension insulators
M – Transformer demonstrated test level
N – Pin type line insulator plus 12" of wood
L – 12" diam air-break switch insulator
K – 13" diam air-break switch insulator
J – Line post insulator 14"
H – Pin type line insulator
G – Protector tube
F – Basic impulse insulation level
E – Line post insulator 11½"
B – 30-kv line type arrester, gap breakdown
D – 30-kv line type arrester, I.R. discharge 20,000 amp.
A – 30-kv station type arrester, gap breakdown
C – 30-kv station type arrester, I.R. discharge 20,000 amp.

TABLE I
CALCULATED NET PROTECTIVE MARGINS FOR TYPICAL 4.16-Kv. DISTRIBUTION EQUIPMENT

	Front of Wave Breakdown in kilovolts for 1½ by 40 m.s. Positive Wave—1,000 Kv./m.s. Rise							Tail of Wave Breakdown in kilovolts—10 m.s. point				
1 Item of Equipment	2 Equipment	3 Arrester (Curve C)	4 Protector Tube (Curve E)	5 Gross Protective Margin (2)−(3)	6 Tolerance in Tube or Arrester Breakdown 25% of (3) or (4)	7 Kv. Rise Due to Lead Length	8 Net Protective Margin—Kv. (5)−(6)+(7)	9 Equipment at 10 Microseconds	10 Arrester IR Drop at 20,000 amp. or Tube at (Note 1) 10 m.s.	11 Gross Protective Margin (9)−(10)	12 20% Tolerance in Arrester or 25% in Tube Breakdown	13 Net Protective Margin—Kv. (11)−(12)
Transformer Demonstrated Test Level (Curve H)	109	23	— 90	86 19	5.75 22.50	12 12	68.25 −15.5	60	24 30	36 30	4.8 7.50	31.2 22.5
Assumed Strength of Old Transf. 1923–1932 (Curve F)	94	23	— 90	71 4	5.75 22.50	12 12	53.25 −30.50	50	24 30	26 20	4.8 7.5	21.2 12.5
Transformer Bushing Pocket Type (Curve K)	114	23	—	91	5.75	12	73.25	82	24	58	4.8	53.2
Pine Type Line Insulator (Curve M)	210	—	90	120	22.5	—	97.5	92	30	62	7.5	54.5
Pin Type Line Insulator plus 12" of Wood (Curve Q)	375	—	90	285	22.5	—	262.5	172	38	142	7.5	134.5
One 6" Disc. Insulator (Curve O)	158	—	90	68	22.75	—	45.25	100	38	70	7.5	62.5
5,000 V. Fuse Switch (Curve J)	167	—	90	77	22.50	—	54.5	73	30	43	7.5	35.5
7,500 V. Fuse Switch (Curve P)	375	—	90	285	22.50	—	262.5	111	30	81	7.5	73.5

Columns 2, 3 and 4 are the breakdown values of the equipment or protection devices at the intersection with the 1,000 Kv./m.s. line on the associated volt-time curves.
Note 1: Since this value is zero for a protector tube, the 10 m.s. point of the tube curve is used instead.

TABLE II
CALCULATED NET PROTECTIVE MARGINS FOR TYPICAL 13.2-Kv. DISTRIBUTION EQUIPMENT

	Front of Wave Breakdown in kilovolts for 1½ by 40 m.s. Positive Wave—1,000 Kv./m.s. Rise							Tail of Wave Breakdown in kilovolts—10 m.s. point				
1 Item of Equipment	2 Equipment	3 Arrester (Curve D)	4 Protector Tube (Curve H)	5 Gross Protective Margin (2)−(3)	6 Tolerance in Tube or Arrester Breakdown 25% of (3) or (4)	7 Kv. Rise Due to Lead Length	8 Net Protective Margin—Kv. (5)−(6)+(7)	9 Equipment at 10 Microseconds	10 Arrester IR Drop at 20,000 amp. or Tube at (Note 1) 10 m.s.	11 Gross Protective Margin (9)−(10)	12 20% Tolerance in Arrester or 25% in Tube Breakdown	13 Net Protective Margin—Kv. (11)−(12)
Transformer Demonstrated Test Level (Curve M)	150	72	—	78	18	20	40	95	62	33	12.4	20.6
Pine Type Line Insulator (Curve O)	290	—	106	184	26.5	—	157.5	150	51	99	12.75	86.25
Pin Type Line Insulator Plus 12" of Wood (Curve S)	460	—	106	354	26.5	—	327.5	225	51	174	12.75	161.25
Line Post Insulator—(Curve N)	390	—	106	284	26.5	—	257.5	130	51	79	12.75	66.25
2–10" by 5¾" Suspension Insulators (Curve T)	448	—	106	342	26.5	—	315.5	249	51	198	12.75	185.25
9" Dia. Airbreak Switch Insulator (Curve Q)	385	—	106	279	26.5	—	252.5	160	51	109	12.75	96.25

Columns 2, 3 and 4 are the breakdowns of the equipment or protective devices at the intersection with the 1,000 Kv./m.s. line on the associated volt-time curves.
Note 1: Since this value is zero for a protector tube, the 10 m.s. point of the tube curve is used instead.

TABLE III
CALCULATED NET PROTECTIVE MARGINS FOR TYPICAL 34.5-Kv. DISTRIBUTION EQUIPMENT

	Front of Wave Breakdown in kilovolts for 1½ by 40 m.s. Positive Wave—1,000 Kv./m.s. Rise							Tail of Wave Breakdown in kilovolts—10 m.s. point				
1 Item of Equipment	2 Equipment	3 Arrester (Curve B)	4 Protector Tube (Curve G)	5 Gross Protective Margin (2)−(3)	6 Tolerance in Tube or Arrester Breakdown 25% of (3) or (4)	7 Kv. Rise Due to Lead Length	8 Net Protective Margin—Kv. (5)−(6)+(7)	9 Equipment at 10 Microseconds	10 Arrester IR Drop at 20,000 amp. or Tube at (Note 1) 10 m.s.	11 Gross Protective Margin (9)−(10)	12 20% Tolerance in Arrester or 25% in Tube Breakdown	13 Net Protective Margin—Kv. (11)−(12)
Transformer demonstrated Test Level (Curve M)	350	125	—	225	31.25	30	163.75	200	149	51	29.8	21.2
Pin Type Line Insulator (Curve H)	445	—	390	55	97.5	—	−42.5	195	200	−5	50	−55
Pin Type Line Insulator Plus 12" of Wood (Curve N)	575	—	390	185	97.5	—	87.5	266	200	66	50	16
Line Post Insulator 11½" (Curve E)	465	—	390	75	97.5	—	−22.5	180	200	−20	50	−70
Line Post Insulator 14" (Curve J)	545	—	390	155	97.5	—	57.5	210	200	10	50	−40
3–10" by 5¾" Suspension Insulators (Curve O)	565	—	390	175	97.5	—	77.5	355	200	155	50	105
13" Diam. Airbreak Switch Insulators (Curve K)	500	—	390	110	97.5	—	12.5	225	200	25	50	−25
12" Diam. Airbreak Switch Insulators (Curve L)	455	—	390	65	97.5	—	−32.5	200	200	0	50	−50

Columns 2, 3 and 4 are the breakdowns of the equipment or protective devices at the intersection with the 1,000 Kv./m.s. line on the associated curves.
Note 1: Since this value is zero for a protector tube, the 10 m.s. point of the tube curves used instead.

factors, such as characteristics of incoming surge, surge impedance of the circuit, branches in the circuit, lead lengths, impedance of grounds, that effect the degree of protection given to equipment, have been assumed to be constant in order to allow direct comparison.

Limit Lead Length

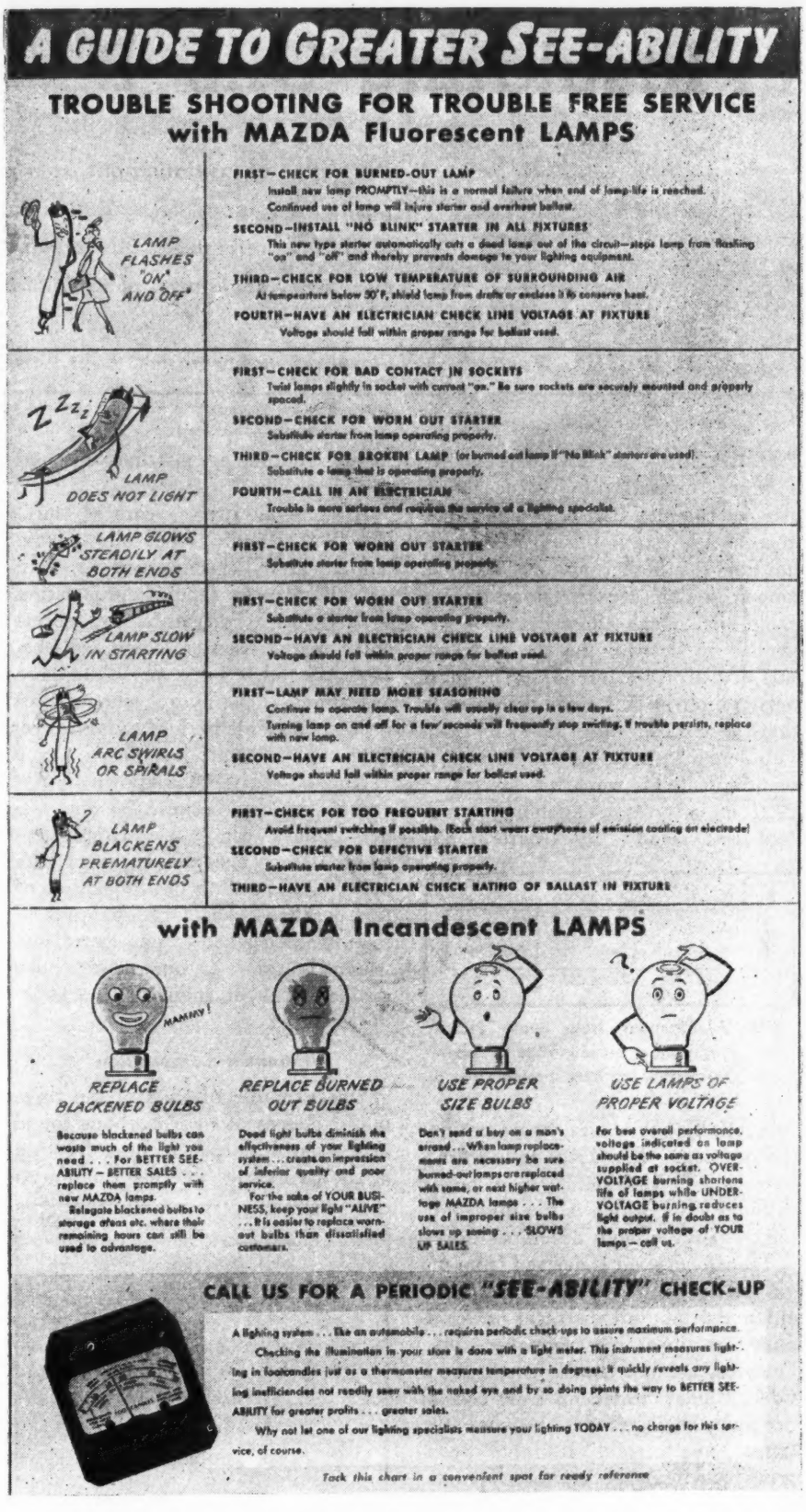
Early in this study, the necessity for definite maximum limitations on the length of lead between protected and protecting equipment became evident. After consideration of the factors involved, it was concluded that leads for the various voltages should not exceed the following lengths:

4.16 kv.— 6 ft.
13.8 kv.—10 ft.
34.5 kv.—15 ft.

Effect of lead strength in general is to delay the time when a reflected wave from an arrester or tube will get back to the incoming wave and begin to cancel its effect. This is a vital consideration and explains the emphasis in recent years on the need for mounting the protective equipment as near to the protected apparatus as possible. Further, this study assumes that arrester and tube ground leads are tied into the grounded portions of protected apparatus at the base of the arrester or tube. This eliminates the effect of voltage built up due to these leads. Consequently, the IR-drop figures shown for arresters result from the resistance of the valve material only. For tubes this figure is zero, an inherent design feature.

It should be pointed out in conclusion that, based on this study, the use of protector tubes for transformer protection except where the windings are designed for their use appears questionable. Limited operating experience with experimental installations of tubes on transformers on the Union Electric System tends to confirm this but sufficient data has not been accumulated to warrant final conclusions. There is further some question as to the accuracy of the curves shown for valve-type arresters for very heavy surge currents in the portion of the curve between the zero and ½ microsecond point. To date, however, these are the best data we have available that can be consistently reproduced in the several laboratories.

For Maintained Lighting Quality


A GUIDE TO GREATER SEE-ABILITY
TROUBLE SHOOTING FOR TROUBLE FREE SERVICE
with MAZDA Fluorescent LAMPS
LAMP FLASHES "ON" AND OFF
FIRST—CHECK FOR BURNED-OUT LAMP
Install new lamp PROMPTLY—this is a normal failure when end of lamp-life is reached.
Continued use of lamp will injure starter and overheat ballast.
SECOND—INSTALL "NO BLINK" STARTER IN ALL FIXTURES
This new type starter automatically cuts a dead lamp out of the circuit—stops lamp from flashing "on" and "off" and thereby prevents damage to your lighting equipment.
THIRD—CHECK FOR LOW TEMPERATURE OF SURROUNDING AIR
At temperature below 50°F, shield lamp from drafts or enclose it to conserve heat.
FOURTH—HAVE AN ELECTRICIAN CHECK LINE VOLTAGE AT FIXTURE
Voltage should fall within proper range for ballast used.
LAMP DOES NOT LIGHT
FIRST—CHECK FOR BAD CONTACT IN SOCKETS
Twist lamps slightly in socket with current "on." Be sure sockets are securely mounted and properly spaced.
SECOND—CHECK FOR WORN OUT STARTER
Substitute starter from lamp operating properly.
THIRD—CHECK FOR BROKEN LAMP (or burned out lamp if "No Blink" starters are used).
Substitute a lamp that is operating properly.
FOURTH—CALL IN AN ELECTRICIAN
Trouble is more serious and requires the service of a lighting specialist.
LAMP GLOWS STEADILY AT BOTH ENDS
FIRST—CHECK FOR WORN OUT STARTER
Substitute starter from lamp operating properly.
LAMP SLOW IN STARTING
FIRST—CHECK FOR WORN OUT STARTER
Substitute a starter from lamp operating properly.
SECOND—HAVE AN ELECTRICIAN CHECK LINE VOLTAGE AT FIXTURE
Voltage should fall within proper range for ballast used.
LAMP ARC SWIRLS OR SPIRALS
FIRST—LAMP MAY NEED MORE SEASONING
Continue to operate lamp. Trouble will usually clear up in a few days.
Turning lamp on and off for a few seconds will frequently stop swirling. If trouble persists, replace with new lamp.
SECOND—HAVE AN ELECTRICIAN CHECK LINE VOLTAGE AT FIXTURE
Voltage should fall within proper range for ballast used.
LAMP BLACKENS PREMATURELY AT BOTH ENDS
FIRST—CHECK FOR TOO FREQUENT STARTING
Avoid frequent switching if possible. (Each start wears away some of emission coating on electrode)
SECOND—CHECK FOR DEFECTIVE STARTER
Substitute starter from lamp operating properly.
THIRD—HAVE AN ELECTRICIAN CHECK RATING OF BALLAST IN FIXTURE
with MAZDA Incandescent LAMPS
MAMMY!
REPLACE BLACKENED BULBS
Because blackened bulbs can waste much of the light you need . . . For BETTER SEE-ABILITY — BETTER SALES . . . replace them promptly with new MAZDA lamps.
Relegate blackened bulbs to storage areas etc. where their remaining hours can still be used to advantage.
REPLACE BURNED OUT BULBS
Dead light bulbs diminish the effectiveness of your lighting system . . . create an impression of inferior quality and poor service.
For the sake of YOUR BUSINESS, keep your light "ALIVE" . . . It is easier to replace worn-out bulbs than dissatisfied customers.
USE PROPER SIZE BULBS
Don't send a boy on a man's errand . . . When lamp replacements are necessary be sure burned-out lamps are replaced with same, or next higher wattage MAZDA lamps . . . The use of improper size bulbs slows up seeing . . . SLOWS UP SALES.
USE LAMPS OF PROPER VOLTAGE
For best overall performance, voltage indicated on lamp should be the same as voltage supplied at socket. OVER-VOLTAGE burning shortens life of lamps while UNDER-VOLTAGE burning reduces light output. If in doubt as to the proper voltage of YOUR lamps — call us.
CALL US FOR A PERIODIC "SEE-ABILITY" CHECK-UP
A lighting system . . . like an automobile . . . requires periodic check-ups to assure maximum performance.
Checking the illumination in your store is done with a light meter. This instrument measures lighting in footcandles just as a thermometer measures temperature in degrees. It quickly reveals any lighting inefficiencies not readily seen with the naked eye and by so doing points the way to BETTER SEE-ABILITY for greater profits . . . greater sales.
Why not let one of our lighting specialists measure your lighting TODAY . . . no charge for this service, of course.
Tack this chart in a convenient spot for ready reference

THIS CHART, 9 in. by 17¼-in., triple folded to make a 9 in. by 5¾-in. mailing piece, is being sent out by the Duquesne Light Co. to commercial and industrial customers. On the back of the chart, the part which is the inside fold of the mailing piece, soap and water, fresh paint and adequate wiring are pointed to as necessary components of good lighting. This chart includes both florescent and mazda lamps

Oxidation Inhibitors in Insulating Oils—I*

Derivation of insulating oils from petroleum—Complexity of their composition—Sources of oxidation, acidification, sludge and corrosion. Moderate refinement advocated as means of retaining inherent stability. Mechanism of inhibition and water formation discussed

L. J. BERBERICH†, Westinghouse Research Laboratories, East Pittsburgh, Pa.

PETROLEUM is an exceedingly complex mixture of hydrocarbons. It is so complex that only some very general information is available regarding the higher boiling fractions among which are transformer and cable oils. Much effort has been expended in determining the composition of petroleum fractions. The most outstanding work in this direction is that undertaken by the American Petroleum Institute at the Bureau of Standards. This work was started in 1927 on a typical Oklahoma (midcontinent) crude. By a careful dis-

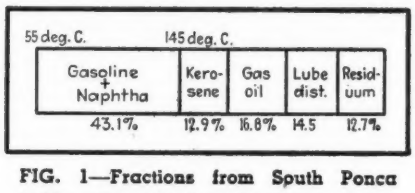


FIG. 1—Fractions from South Ponca field crude under investigation in American Petroleum Institute Project No. 6

tillation, the crude was separated into the fractions (Fig. 1). The last fraction called "residuum" is a heavy cylinder stock which is too high boiling to distill without decomposition.

Transformer oil is derived from the gas oil fraction and cable oils from either the lube oil distillate or residuum fractions. Transformer oils, however, are not usually made from midcontinent crudes but from coastal or naphthenic crudes because the latter have certain desirable properties, particularly low pour points. Cable oils have been made from all of the three main types of crudes, although most of the cable oils used at the present time are also derived from coastal crudes.

After about twelve years of work, Dr. F. D. Rossini, who followed the late Dr. E. W. Washburn in directing the API project, reports the isolation of 46 hydrocarbons from the gasoline and naphtha fraction which boils between 55 and 145 deg. C. While there are about 1,000 hydrocarbons theoretically possible in this boiling range, only about 100 are known.

Almost one-half the known hydrocarbons boiling between 55 and 145 deg. C. have been isolated from petroleum. It thus becomes apparent why petroleum is such a prolific source of hydrocarbons. The large amounts of butadiene derived from petroleum which is used in our newly born synthetic rubber industry is a striking example.

Complex Composition

One example of each of the three major classes of hydrocarbons found in the gasoline and naphtha fraction is shown in Fig. 2. This fraction is

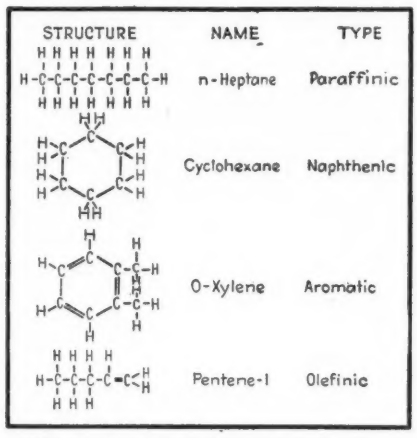


FIG. 2—Typical hydrocarbons in gasoline fraction

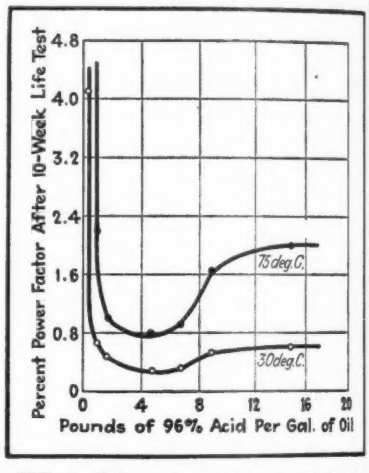


FIG. 3—Effect of severity of acid treatment on stability of oil-treated insulation

richest in the paraffinic type and poorest in the aromatic type, the naphthenic type being intermediate. The last type listed, namely the olefinic type, was not found in this fraction. However, there is evidence that it exists in the higher boiling fractions probably as side chains in some of the ring structures. This type is similar to the paraffinic type except that it contains double bonds. The cyclic or ring type of hydrocarbon, which includes the naphthenic and aromatic structures, can become very complicated by side chains and multiple rings.

The higher boiling fractions are far more complex and the complexity increases with the boiling point. The properties of the individual hydrocarbons lie closer together, which makes it exceedingly difficult to separate them.

Hydrocarbon containing 30 carbon atoms, which approximates the av-

*Adapted from paper at recent meeting of Pennsylvania Electric Association's Electrical Equipment Committee at Johnstown, Pa.

†Section Engineer, Insulation Department.

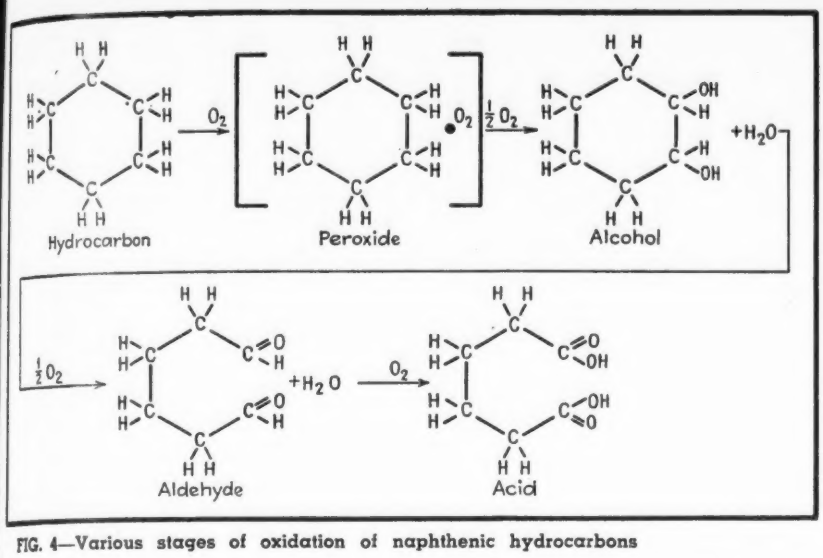


FIG. 4—Various stages of oxidation of naphthenic hydrocarbons

erage number of carbon atoms expected to be found in lubricating oil fractions, has the possibility of having about four billion isomers.

Fortunately, most of these isomers are missing and fortunately also the largest portion of the oil is made up of relatively few of the isomers. Any particular isomer represents one of the possible ways of arranging a given number of carbon and hydrogen atoms into a molecule.

No single individual hydrocarbon has, to the writer's knowledge, ever been isolated from the lubricating oil fraction. Only the hydrogen-to-carbon ratio, the average molecular weights, and general molecular formulas have been determined. Besides the straight hydrocarbons, all crudes contain minor proportions of compounds having sulphur, nitrogen, and oxygen in the molecule.

This discussion on the constitution of petroleum indicates the complexity of the problem of studying the reactions which insulating oils may enter into with oxygen and other deteriorating influences. This applies even more so to the study of inhibitors, since the behavior of any specific inhibitor will vary widely, depending on the nature of the oil to which it is added. It can, however, be said without too much speculation, that the hydrocarbons in the moderately refined insulating oils used in this country consist largely of a mixture of napthenic and aromatic hydrocarbons. The paraffines are largely absent in the higher boiling fractions except that in certain crudes they are present as waxes, which are largely removed in modern methods of refining. The proportion of aromatics is highest in the coastal crudes and becomes quite small in the Pennsylvania crudes.

Influence of Refining

Most common method of refining insulating oils consists of treating the distillate with sulphuric acid, neutralizing it with caustic and finally treating it with clay. The newer solvent refining methods have also been employed but not with universal success. Refining removes, first of all, the compounds containing sulphur, oxygen, and nitrogen, and those having olefinic unsaturation. As the severity of the acid treatment is increased, the aromatics are removed in increasing amounts. Finally, after very severe treatment, only the naphthenes (and paraffines if any are present) remain. This, very briefly, gives the functions of the refining process.

Most of the early transformer oils were rather highly refined. The conservative design and the low temperature of operation of these early transformers enabled these oils to give a good account of themselves. However, the higher temperatures in the more modern transformers brought to light that such oils form acids fairly rapidly in service. These acids not only corrode the metal parts, but also attack and eventually destroy the cellulosic materials used in the insulation of the windings. This stimulated many investigations which had for their purpose the determination of the optimum degree of refining. All of this work done in many places led to the conclusion that *highly refined oils tend to form acids and lightly refined oils tend to form sludge.* A moderately refined oil was found to be the best compromise which led to the adoption of this type of oil for transformer use in this country and a considerable number of countries abroad. The wisdom of this choice is borne out by the very favorable service record shown by the modern transformer oils.

Moderate Refining

Similarly, for cable and capacitor impregnants, moderately refined oils are also desirable from the standpoint of maximum life. F. M. Clark investigated the effect of degree of refinement on the performance of experimental capacitors under voltage stress in an accelerated life test. He used power factor as the criterion of stability and some of his results are shown in Fig. 3. These data indicate, for the particular crude he investigated, that about six pounds of 96 percent sulphuric acid per gallon of oil results in maximum stability. Clark has also shown that the oil refined for maximum stability contains a considerable proportion of aromatic hydrocarbons.

The writer has also shown, that from the standpoint of stability to gaseous electric discharge, a certain amount of aromatic hydrocarbon content is desirable. In this work it was shown furthermore that the stability of a highly refined oil can be markedly improved by adding such a simple aromatic hydrocarbon as diphenyl. Addition of diphenyl decreases the gas evolution when the oil is subjected to gaseous electric discharge.

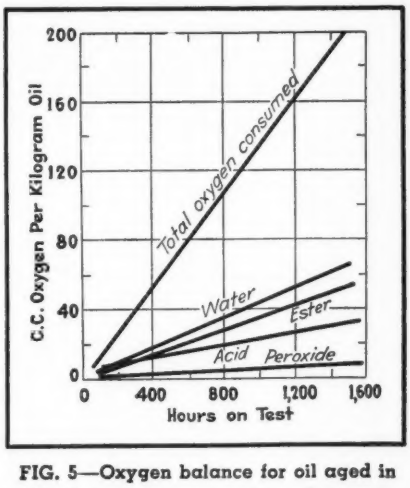


FIG. 5—Oxygen balance for oil aged in closed vessel in presence of oxygen

It is thus evident that a moderate degree of refining is desirable for all insulating oils whether for transformer, cable, or capacitor use. Also,

moderately refined oils contain an appreciable percentage of aromatic hydrocarbons which are desirable from the standpoint of stability in cables and capacitors. In transformer oils, on the other hand, where oxidation is the only important deteriorating influence, it is doubtful whether aromatic hydrocarbons as such play any important role. Considerable evidence has been presented that all oils contain natural inhibitors which slow down the oxidation process. There is also evidence that these inhibitors are derivatives of aromatic hydrocarbons which may be removed with the ordinary aromatic hydrocarbons by over-refining the oil. Hence, it is believed that for this reason it is also desirable to have a certain amount of aromatic hydrocarbon content in transformers. The fact that most of the effective oxidation inhibitors are derivatives of aromatic hydrocarbons lends some support to this view.

Oxidation Inhibition

The original conception of oil stability has been associated with the inherent resistance of the oil molecules toward oxidation, and refining was supposed to remove all the unstable oil molecules present. This view was held until the classical work of Moureu and Dufraisse in 1922 revealed the existence of oxidation inhibitors. An inhibitor may be defined as a substance capable of protecting the less stable molecules from oxidation even when such substances are present in exceedingly small amounts, a few hundredths percent or less. In the last 20 years many substances have been found to be amenable to oxidation control by use of inhibitors. Among these are vegetable and animal fats, waxes, hydrocarbon oils, and rubber.

What little is known regarding the mechanism of oxidation inhibition indicates that the action of all inhibitors depends on their own oxidizability. Both the inhibitor and the hydrocarbon oxidize to the peroxide stage. These two types of peroxides are supposed to be mutually antagonistic and then destroy each other. The hydrocarbon, inhibitor, and oxygen are regenerated in the process. When the inhibitor is not present the reaction between hydrocarbon and oxygen goes through the peroxide and several other stages until finally water and acids are produced.

The various stages of oxidation through which a typical naphthenic hydrocarbon, namely cyclohexane, may go are shown in Fig. 4. First, the oxygen complex or peroxide is formed, then the hydroxyl or alcohol derivative, next the aldehyde derivative in which the ring is severed, and finally the acid stage is reached. This indicates only one of a number of ways in which the reaction may go. For example, the ring may be broken in several places and the reaction on the one end of the hydrocarbon fragment may proceed faster than on the other end.

Water and Metal Salts

Water is formed (Fig. 4) in several of the oxidation stages. That relatively large amounts of water are formed during the oxidation of hydrocarbon oils is indicated in Fig. 5. These data, obtained by Larsen, indicate the oxygen balance for an oil aged in a closed vessel in the presence of oxygen. By far the major proportion of the oxygen consumed by the oil goes into producing water. No alcohols or aldehydes were found, but considerable oxygen went into formation of esters which are reaction products between alcohols and acids.

Certain metals are always in contact with insulating oils in service. Some of the metals, particularly copper, lead, and iron catalyze or accelerate the oxidation reactions, copper being the most active in this respect. These metals can also react with the oxidation products, particularly the acids. In the case of the acids, metal salts are formed which are called soaps. The point to be emphasized in this connection is that metals can profoundly influence the oxidation reactions and in any study of inhibitors for insulation oils the effects of the contacting metals must be considered.

This and other factors of inhibitor behavior will be discussed in an ensuing installment.

How to Care For Leather Goods

Safety straps and tool belts when given proper attention will have a longer life and give more satisfactory service. Such are the results which can be obtained if a few rules are observed. Following instructions for the maintenance of leather goods are adapted from Overhead Construction Standards of New England Power System.

1. Go over leather at least once every 90 days and scrape out the "scale" that forms whenever metal rubs against the leather. Examine for stretch, wear, cracks and cuts.

2. Wash off all surface dirt with a sponge, using a pure soap (Castile or Ivory are good). Work up a thick lather—use minimum of water.

3. Wipe dry as possible.

4. While leather is still damp take a small quantity of Neatsfoot oil on a rag and rub into the leather on the hair or grain side. Don't flush the oil on from the can. Too much oil overlubricates the strength fibers, making the leather flabby and stretchy.

In storage particular care should be taken to keep belts and straps away from direct or close contact with heat, such as steam coils, radiators or stoves. Leather exposed to such conditions rapidly deteriorates and loses its tensile strength. It becomes dry, brittle and unreliable. After exposure to water or acid, belts and straps should be wiped off as quickly as possible with an oily rag dipped in Neatsfoot oil as before described.

Damp or wet leather should never be dried with the aid of heat. Such treatment weakens the fiber of the leather, and may even destroy it if the temperature used is sufficiently high.

Bend Test—This should only be made when leather contains sufficient oil to make it soft and pliable. Bend the leather slowly with the grain (black) side out over a mandrel not less than ½ inch in diameter through an angle of 180 deg. Do not bend at buckle holes in any case. If leather of such thickness as used in belts and straps is abused by abrupt bending without a mandrel, the leather may develop cracks on account of the excessive strain put on the grain side. When tested as directed above the leather should show no cracks although there may be a slight opening up of the grain surface.

ELECTRICAL WORLD • February 17, 1945 Pages 93 to 95, incl.

HOW TO DETERMINE VOLTAGE DROP ON TRANSMISSION AND DISTRIBUTION CIRCUITS

By F. R. LONGLEY, Electrical Engineer, Western Massachusetts Electric Co., Springfield, Mass.

Nomograph covers practically every condition of construction, load and power factor, from interior wiring to very large transmission circuits. It also shows the reactances and resistances and, if desired, may be used within its range for those values in place of the standard tables. In addition, it can be used to obtain the voltage drops of apparatus, such as transformers, when their reactances and resistances are known. The chart is highly accurate and has proven to be very useful and convenient. A non-technical user only needs to be able to read a scale and to multiply.

Instructions for Use of Chart

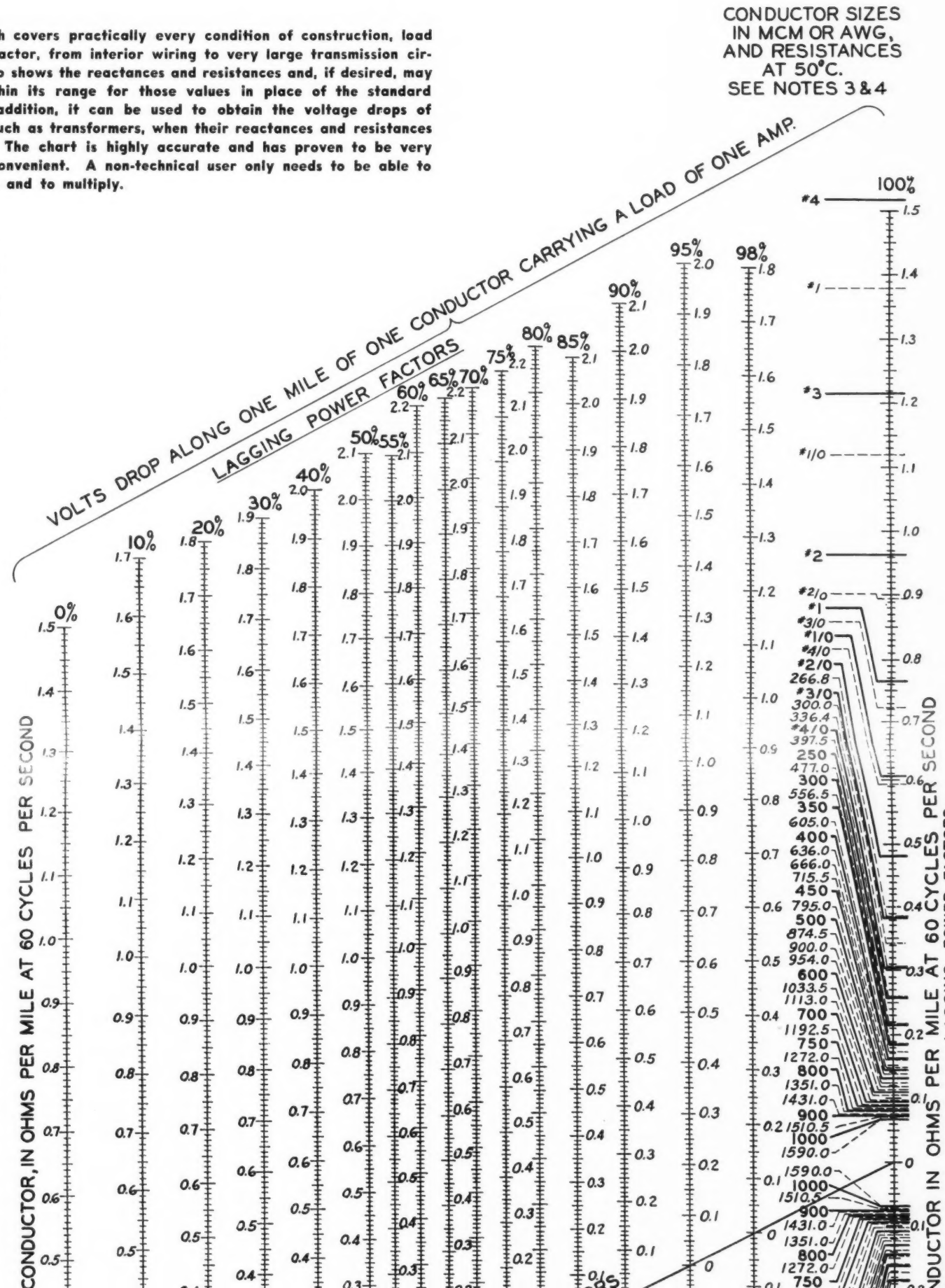
Lay a straight edge to intersect conductor size on left hand (GMR) scale and conductor spacing on adjacent scale.

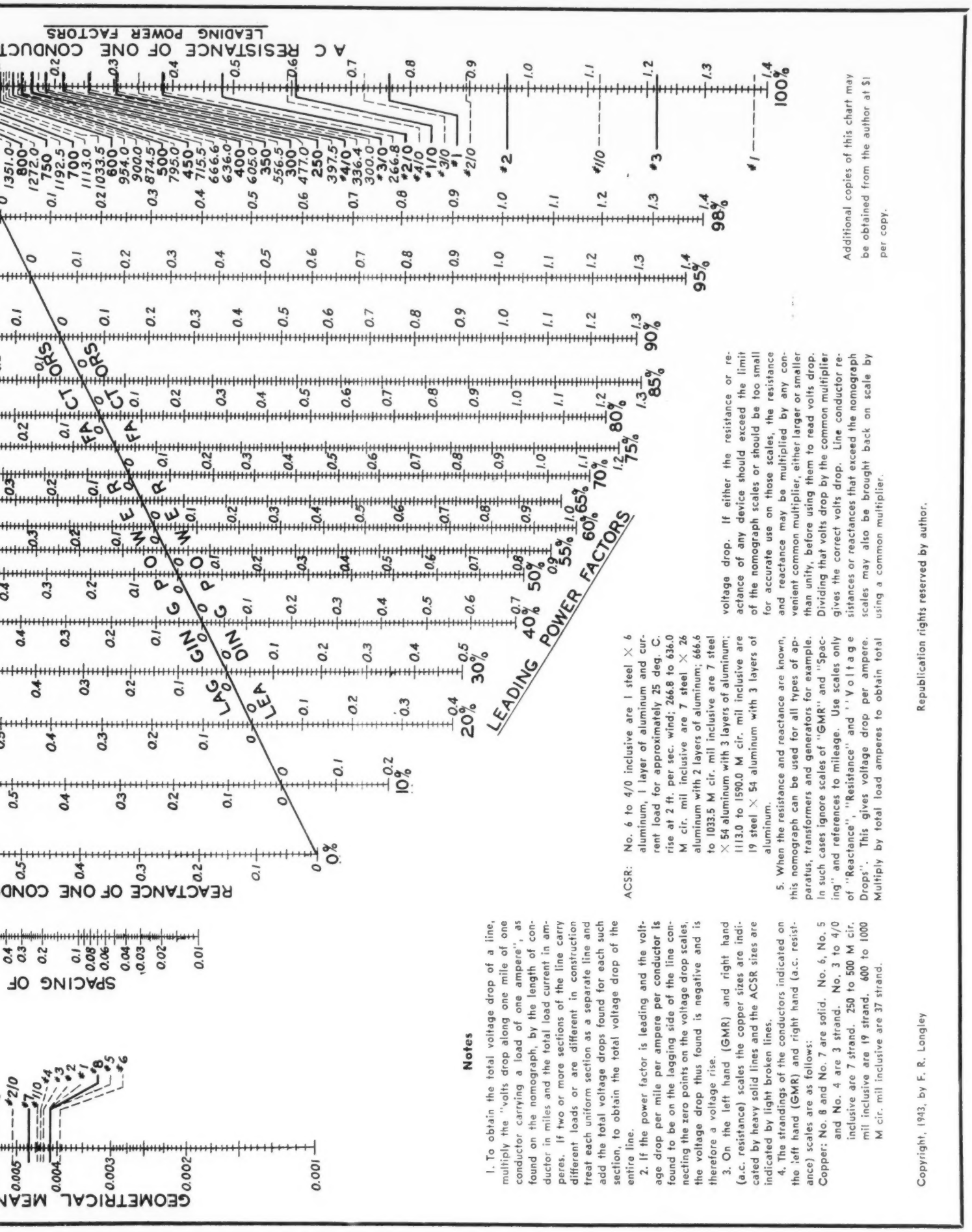
Read conductor reactance where straight edge crosses that scale, which is third scale from the left.

Lay a straight edge to intersect reactance on reactance scale and conductor size on resistance scale on extreme right.

Read volts drop per conductor per mile per ampere where straight edge crosses voltage drop scale at load power factor.

See notes below.





Notes

1. To obtain the total voltage drop of a line, multiply the "volts drop along one mile of one conductor carrying a load of one ampere", as found on the nomograph, by the length of conductor in miles and the total load current in amperes. If two or more sections of the line carry different loads or are different in construction treat each uniform section as a separate line and add the total voltage drops found for each such section, to obtain the total voltage drop of the entire line.

2. If the power factor is leading and the voltage drop per mile per ampere per conductor is found to be on the lagging side of the line connecting the zero points on the voltage drop scales, the voltage drop thus found is negative and is therefore a voltage rise.

3. On the left hand (GMR) and right hand (a.c. resistance) scales the copper sizes are indicated by heavy solid lines and the ACSR sizes are indicated by light broken lines.

4. The strandings of the conductors indicated on the left hand (GMR) and right hand (a.c. resistance) scales are as follows:

Copper: No. 8 and No. 7 are solid. No. 6, No. 5 and No. 4 are 3 strand. No. 3 to 4/0 inclusive are 7 strand. 250 to 500 M cir. mil inclusive are 19 strand. 600 to 1000 M cir. mil inclusive are 37 strand.

ACSR: No. 6 to 4/0 inclusive are 1 steel × 6 aluminum, 1 layer of aluminum and current load for approximately 25 deg. C. rise at 2 ft. per sec. wind; 266.8 to 636.0 M cir. mil inclusive are 7 steel × 26 aluminum with 2 layers of aluminum; 666.6 to 1033.5 M cir. mil inclusive are 7 steel × 54 aluminum with 3 layers of aluminum; 1113.0 to 1590.0 M cir. mil inclusive are 19 steel × 54 aluminum with 3 layers of aluminum.

5. When the resistance and reactance are known, this nomograph can be used for all types of apparatus, transformers and generators for example. In such cases ignore scales of "GMR" and "Spacing" and references to mileage. Use scales only of "Reactance", "Resistance" and "Voltage Drops". This gives voltage drop per ampere. Multiply by total load amperes to obtain total voltage drop. If either the resistance or reactance of any device should exceed the limit of the nomograph scales or should be too small for accurate use on those scales, the resistance and reactance may be multiplied by any convenient common multiplier, either larger or smaller than unity, before using them to read volts drop. Dividing that volts drop by the common multiplier gives the correct volts drop. Line conductor resistances or reactances that exceed the nomograph scales may also be brought back on scale by using a common multiplier.

Additional copies of this chart may be obtained from the author at $1 per copy.

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EXAMPLES

Example 1 HIGH TENSION TRANSMISSION LINE.

Problem: A double-circuit, 115-kv. transmission line of 336.4 M cir. mil ACSR is 40 miles long. The conductors of each circuit are arranged in horizontal configuration with spacings of 11 ft. and 18.5 ft. The line current is 240 amp. per conductor (95,600-kva. double-circuit load) at 85% lagging power factor. What is the voltage drop of the line?

Solution: Equivalent conductor spacing per circuit = cube root of $(11) \times (18.5) \times (11+18.5) = 18.17$ ft.

With a straight edge at 336.4 M cir. mil ACSR on the GMR scale of the nomograph, and at 18.17 ft. on the Spacing-of-Conductors scale, read on the Reactance scale 0.801 ohm reactance per mile of one conductor.

With the straight edge at 0.801 ohm on the Reactance scale of the nomograph, and at 336.4 M cir. mil ACSR on the Resistance scale for lagging power factors, read 0.681 volt drop along one mile of one conductor carrying a load of one ampere at 85% power factor.

Voltage drop of line = (0.681 volt drop per mile per amp.) × (40 miles) × (240 amp.) = 6,540 volts drop to neutral.

Percent voltage drop of line =

$$\frac{100 \times (6540)}{115{,}000/\sqrt{3}} = 9.85\%$$

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Example 2—RURAL LINE

Problem: A 4,800-volt, single-phase rural line of No. 2 ACSR is 8 miles long. The conductor spacing is 59 in. At a point 5 miles from its origin the line supplies 25 amp. (120 kva.) at 60% lagging power factor to a small scattered community. A small rural factory, located at the end of the line, takes a load of 15 amp. (72 kva.) at 50% lagging power factor. Also, at the end of the line a capacitor rated 180 kva. is installed to prevent the occurrence of low voltage. What is the voltage drop of the line?

Solution: Calculating the total load on the last 3 miles of line, it is found to be 25.63 amp. at 29.3% leading power factor.

Calculating the total load on the first 5 miles of line, it is found to be 22.95 amp. at 98.0% leading power factor.

With a straight edge at No. 2 ACSR on the GMR scale of the nomograph, and at 4.92 ft. (59 in.) on the Spacing-of-Conductors scale, read on the Reactance

scale 0.859 ohm reactance per mile of one conductor.

The resistance per mile of No. 2 ACSR is off scale on the Resistance scale of the nomograph, therefore, the volts drop of one conductor at one ampere will be arbitrarily taken for ½ mile of conductor instead of for the one mile for which the nomograph has been drawn.* (See Note No. 5 of the nomograph.)

From wire tables, the resistance of No. 2 ACSR at 50 deg. C. and as specified for ACSR in Note 4 of the nomograph, is found to be 1.69 ohms per mile. The resistance for ½ mile is, therefore, 0.845 ohm. From the reactance per mile as previously found, the reactance of ½ mile is 0.4295 ohm.

With the straight edge at 0.4295 ohm on the Reactance scale of the nomograph and at 0.845 ohm on the Resistance scale for leading power factors, read 0.742 volt drop along ½ mile of one conductor carrying a load of one ampere at 98% power factor. The volts drop per mile per ampere per conductor is therefore $(0.742) \times (2) = 1.484$ volts.

The voltage drop of the first 5 miles of line = (1.484 volts) × (2 wires) × (5 miles) × (22.95 amp.) = 341 volts drop to the community.

Percentage voltage drop to the community = $100(341)/4{,}800 = 7.10\%$.

With the straight edge at 0.4295 ohm on the Reactance scale of the nomograph and at 0.845 ohm on the Resistance scale for leading power factors, read —0.16 volt drop along ½ mile of one conductor carrying a load of one ampere at 29.3% power factor. (Interpolate between the 20% and 30% power factor scales for volts drop at 29.3% power factor. Also note that the volts drop in this case is read on the opposite side of the zero line from the resistance scale for leading power factors, and is therefore a negative voltage drop or a voltage rise. See Note No. 2 on the nomograph). Volts drop per mile per ampere per conductor = $(-0.16) \times (2) = -0.32$ volt.

The voltage drop for the last 3 miles is (—0.32) × (2 wires) × (3 miles) × (25.63 amp.) = —49 volts or a voltage rise of 49 volts.

The entire voltage drop of the line is 341 — 49 = 292 volts.

Percent voltage drop of the entire line = $100(292)/4{,}800 = 6.08\%$.

Sometimes it is helpful to show the effect on the voltage drop of the line, of each individual load (including any capacitor load).

This may be done as follows:

The load of the community is 25 amp. at 60% lagging power factor. Using the nomograph in the manner previously explained for this example, obtain 0.851 volt drop per conductor, per ½ mile per ampere at 60% lagging power factor. Volts drop per mile per ampere per conductor = $(0.851) \times (2) = 1.702$ volts. Voltage drop produced by the community's own load only = (1.702 volts) × (2 wires) × (5 miles) × (25 amp.) = 426 volts or $100(426)/4{,}800 = 8.87\%$

The load of the factory is 15 amp. at 50% lagging power factor. From the nomograph obtain 0.794 volt drop per conductor, per ½ mile, per ampere at 50% lagging power factor. Volts drop per mile per ampere per conductor = $(0.794) \times (2) = 1.588$ volts. Voltage drop to the community, produced by the factory load only = (1.588 volts) × (2 wires) × (5 miles) × (15 amp.) = 238 volts or $100(238)/4.800 = 4.96\%$.

The load of the capacitor is 37.5 amp. at 0% leading power factor. From the nomograph obtain —0.4295 volt drop per conductor, per ½ mile, per ampere at 0% leading power factor. Volts drop per mile per ampere per conductor = $(-0.4295) \times (2) = -0.859$ volt. Voltage drop to the community, produced by the capacitor load only = (—0.859 volt) × (2 wires) × (5 miles) × (37.5 amp.) = —322 volts = a voltage rise of 322 volts or, a voltage rise of $100(322)/4{,}800 = 6.71\%$.

The voltage drop to the community, produced by the loads of both the community and the factory, is 426 + 238 = 664 volts or 13.83%.

The total voltage drop to the community is produced by the loads of the community, the factory and the capacitor and is 426 + 238 — 322 = 342 volts or 7.12%. Compare this with the total voltage drop obtained by the first method.

The voltage drop to the factory produced by the load of the community only is also 426 volts, or 8.87% as previously found for the voltage-drop to the community produced by its own load only.

The voltage drop to the factory, produced by the load of the factory only, is (1.588 volts) × (2 wires) × (8 miles) × (15 amp.) = 381 volts, or 7.94%.

The voltage drop to the factory, produced by the loads of both the community and the factory is 426 + 381 = 807 volts or 16.81%.

The voltage drop to the factory, produced by the capacitor load only is (—0.859 volt) × (2 wires) × (8 miles) × (37.5 amp.) = —515 volts = a voltage rise of 515 volts or 10.73%.

The total voltage drop to the factory is produced by the loads of the community, the factory and the capacitor and is 426 + 381 —515 = 292 volts or 6.08%. Compare this with the voltage drop obtained by the first method.

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Example 3 — Overhead Secondary Distribution Main with Uniformly Distributed Load

Problem: An overhead, 3-wire, single phase, secondary main of No. 2 copper, operating at 115/230 volts, is 1,100 ft. long. It consists of two sections, one on each side of its distribution transformer and extending in different directions. The main is supported on standard 3-spool, 8-in. spacing, secondary racks with the neutral wire on the top spool. It serves a distributed load of approximately uniform density of 15 kw. per 1,000 ft. at 93% lagging power factor. The two sections of the secondary main are of unequal length. The longer section extends 600 ft. from the transformer. The shorter section is 500 ft. long. What is the maximum voltage drop of the secondary main?

Solution: Since the load density is the same on both sections, the maximum voltage drop will, of course, occur at the end of the longer 600-ft. section. Therefore, only this section need be used to determine the maximum voltage drop of the secondary main.

It is assumed that load unbalance between "hot" wires and neutral is too slight to have any appreciable effect on voltage drop.

The voltage drop of any line is directly proportional to the integrated product of its load and distance.

When all the load is concentrated at the end of a line, the integrated product of its load and distance is simply the product of that load and the total length of the line.

When the load is uniformly distributed along the line, as in this example, the integrated product of its load and distance is exactly one-half of what it would be if all the load should be concentrated at the end of the line.

The total load of the 600-ft. section is 15(600/1,000) = 9 kw.

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* Another conductor which is off scale on the Resistance scale of the nomograph, and which has been commonly used for primary mains and older types of rural lines, is No. 6 copper. Like the No. 2 ACSR, the No. 6 copper conductor should also be used on the nomograph in units of ½ mile instead of 1 mile. The 60-cycle resistance at 50 deg. C. of solid and 3-strand hard drawn No. 6 copper conductors is 1.195 and 1.025 ohms per ½ mile respectively (almost the same as resistance per mile of the No. 3 copper as marked on the Resistance scale). Of course, the reactance of this conductor, as used on the Reactance scale of the nomograph, should also be for ½ mile instead of 1 mile. This is obtained by getting the reactance per mile from the nomograph in the regular way and then merely dividing by 2.

EXAMPLES FOR NOMOGRAPH OF VOLTAGE DROPS

(continued)

In this example the integrated product of line load and distance is, therefore, $(9) \times (600)/2 = 2{,}700$ kw.-ft., and the voltage drop is the same as that which would be produced by a single load of 2,700 kw.-ft./600 ft. = 4.5 kw. concentrated at the end of the section. (A concentrated load of 9 kw. at the center of the section could also be used. In fact, any combination of any load and length of line could be used to calculate the voltage drop of this section, provided the product of the two remained 2,700 kw.-ft.)

The current of the *equivalent* concentrated load (4.5 kw. at 93% lagging power factor and 230 volts) figures out to 21.04 amp.

With a straight edge at No. 2 copper on the GMR scale of the nomograph and at 0.67 ft. (8 in. which is the spacing between the "hot" conductors) on the Spacing-of-Conductors scale, read on the Reactance scale 0.525 ohm reactance per mile of one conductor.

With the straight edge at 0.525 ohm on the Reactance scale of the nomograph and at No. 2 copper on the Resistance scale for lagging power factors, read 1.09 volts drop along one mile of conductor carrying a load of one amp. at 93% power factor. (Interpolate between the 90% and 95% power factor scales for volts drop at 93% power factor.)

Maximum voltage drop of secondary main = (1.09 volts) × (2 wires) × (600 ft./5,280 ft. per mile) × (21.04 amp.) = 5.21 volts.

Percent maximum voltage drop of secondary main = 100(5.21)/230 = 2.26%.

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Example 4 — Overhead Secondary Distribution Main with a Uniformly Distributed Load Plus a Motor Running Load

Problem: A single-phase, 2-hp. 230-volt motor loaded to about 75% of its rating is connected to the far end of the 600-ft.section of the secondary main of Example 3. The motor draws 8 amp. at 85% power factor. What is the maximum voltage drop of the secondary distribution main?

Solution: Maximum voltage drop will occur at the end of the 600-ft. section and the voltage drop of only that section need be determined.

Obtain line reactance of 0.525 ohm per conductor per mile as in Example 3.

With a straight edge at 0.525 ohm on the Reactance scale of the nomograph, and at No. 2 copper on the Resistance scale for lagging power factors, read 1.097 volts drop along one mile of one conductor carrying a load of one ampere at 85% power factor.

Voltage drop of section, caused by motor only, when running = (1.097 volts) × (2 wires) × (600 ft./5,280 ft.) × (8 amp.) = 1.99 volts or 100 (1.99)/230 = 0.87%.

Total voltage drop of section = 5.21 volts drop from Example 3, plus 1.99 volts drop caused by motor only when running = 7.20 volts

Percent voltage drop of section = 100(7.20)/230 = 3.13%.

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Example 5 — Overhead Secondary Distribution Main with Uniformly Distributed Load Plus a Motor Starting Load

Problem: The motor in Example 4 draws a starting current of 45 amp. at 35% lagging power factor. What is the voltage drop of the secondary main caused by the motor starting load only? (This is a sudden dip in voltage and may cause a noticeable flicker in the illumination from lamps connected to the same main.) What is the maximum voltage drop of the secondary main when the motor is being started?

Solution: As in the previous example it is only necessary to consider the 600-ft. section of the secondary main; also obtain line reactance of 0.525 ohm per conductor per mile.

With a straight edge at 0.525 ohm on the Reactance scale of the nomograph and at No. 2 copper on the Resistance scale for lagging power factor, read 0.83 volt drop along one mile of one conductor carrying a load of one ampere at 35% power factor. (Interpolate between 30% and 40% power factors for voltage drop at 35% power factor.)

Voltage drop of section, caused by motor starting current only = (0.83 volt) × (2 wires) × (600 ft./5,280 ft.) × (45 amp.) = 8.49 volts or 100(8.49)/230 = 3.69%.

Total voltage drop of section = 5.21 volts drop from previous example plus 8.49 volts drop caused by motor starting current only = 13.70 volts.

Percent voltage drop of section = 100(13.70)/230 = 5.95%.

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Example 6—Secondary Distribution Transformer and Its Overhead Secondary Distribution Main with Uniformly Distributed Load Plus Either a Running or Starting Motor Load

Problem: The secondary main of Example 3 is supplied from a 25-kva. distribution transformer which has a resistance of 1.55% and a reactance of 2.71%. The entire length of the secondary main is 1,100 ft. (This is the sum of the two sections which extend from each side of the transformer, 600 ft. in one direction and 500 ft. in another.) What are the voltage drops through the transformer, and what are the combined maximum voltage drops of the transformer and secondary main, caused by:

(a) The distributed load of Example 3?

(b) The distributed load of Example 3 plus the motor running load of Example 4?

(c) The distributed load of Example 3 plus the motor starting load of Example 5?

Solution: Again, as in Examples 3, 4 and 5, since the maximum voltage drops along the secondary main occur at the end of the 600-ft. section of Example 3, the voltage drops of the main need be determined on that section only.

When a large number of transmission elements of different impedance characteristics (two elements consisting of the step-down transformer and the secondary main, in this case) and/or loads of different power factors or locations (the distributed load, the motor running load and the motor starting load in this case), when all these are to be considered separately and in various combinations, it will help avoid confusion and clarify the understanding of the solution, if the various voltage drops and their combinations are set down in tabular form as each voltage drop is calculated.

Those voltage drops of Examples 3, 4, 5 and 6 may be conveniently listed as shown in the accompanying table.

The data in the first two columns of voltage drop are from Examples 3, 4 and 5. Those in the last four columns are from this example.

The rated transformer current is

25,000/230 = 108.70 amp. At full load its resistance drop is (1.55) × (230)./100 = 3.56 volts on the secondary side. Its resistance is 3.56/108.70 = 0.03275 ohm at the 230-volt secondary terminals. Likewise, its reactance drop at full load is (2.71) × (230)/100 = 6.23 volts on the secondary side and its reactance is 6.23/108.70 = 0.0573 ohm at the 230 volt secondary terminals.

The reactance and resistance are too small to use accurately on the Reactance and Resistance scales of the nomograph. Each will, therefore, be arbitrarily multiplied by 10 for convenience and the voltage drop then found will be corrected by dividing by 10. (See Note No. 5 of the nomograph.)

The arbitrary reactance and resistance used will, therefore, be 0.573 ohm and 0.3275 ohm respectively.

With a straight edge at 0.573 ohm on the Reactance scale of the nomograph and at 0.3275 ohm on the Resistance scale for lagging power factors, read 0.51 volt drop at a load of one ampere and 93% power factor. (Interpolate between 90% and 95% power factors for volts drop at 93% power factor.)

The distributed load of the entire secondary main is 15(1,100/1,000) = 16.5 kw. and its current, which of course must be supplied by the transformer, is 77.14 amp. at 230 volts and 93% power factor.

Voltage drop of transformer, caused by entire distributed load of secondary main = (0.51) × (77.14)/10 = 3.93 volts or 100(3.93)/230 = 1.71%.

Combined voltage drops of transformer and 600-ft. section of secondary main, caused by the distributed load only = 5.21 volts drop from Example 3 plus 3.93 volts drop through the transformer = 9.14 volts or 100(9.14)/230 = 3.97%.

With a straight edge at 0.573 ohm on the Reactance scale of the nomograph and at 0.3275 ohm on the Resistance scale for lagging power factors, read 0.579 volt drop at a load of one ampere and 85% power factor.

Voltage drop through transformer, caused by motor running load only of Example 4 = (0.579) × (8)/10 = 0.46 volt or 100(0.46)/230 = 0.20%.

Voltage drop through transformer, caused by the distributed load plus the motor running load of Example 4 = 0.46 volt drop caused by motor load + 3.93 volts drop caused by distributed load = 4.39 volts or 100(4.39)/230 = 1.91%.

Combined voltage drops of transformer and 600-ft. section of secondary main, caused by distributed load plus motor running load of Example 4 = 4.39 volts drop through the transformer + 7.20 volts drop of secondary = 11.59 volts or 100(11.59)/230 = 5.04%.

With a straight edge at 0.573 ohm on the Reactance scale of the nomograph and at 0.3275 ohm on the Resistance scale for lagging power factors, read 0.65 volt drop at a load of one ampere and 35% power factor. (Interpolate between 30% and 40% power factor readings to obtain the 35% power factor reading.)

Voltage drop through transformer, caused by motor starting load only of Example 5 = (0.65) × (45)/10 = 2.92 volts or 100(2.92)/230 = 1.27%.

Voltage drop through transformer, caused by the distributed load plus the motor starting load of Example 5 = 2.92 volts drop caused by motor starting load + 3.93 volts drop caused by distributed load = 6.85 volts or 100(6.85)/230 = 2.98%.

Combined voltage drop of transformer and 600-ft. section of secondary main, caused by distributed load plus motor starting load of Example 5 = 6.85 volts drop through the transformer + 13.70 volts drop of secondary = 20.55 volts or 100(20.55)/230 = 8.93%.

Of the 20.55 volts drop through the transformer and along the secondary main during motor starting operations, that part caused by the motor starting load only is a sudden dip and amounts to 2.92 volts drop through the transformer + 8.49 volts drop along the secondary = 11.41 volts drop or 100(11.41)/230 = 4.96%. (This voltage dip will cause a sudden drop of about 16% in the illumination of lamps at the far end of the 600-ft. section of secondary. At the transformer the voltage dip will be 2.92 volts or 1.27% and will cause a sudden dip of about 4% in the illumination of lamps at that location. The illumination dip of 16% will be noticeable as a distinct flicker. The degree of annoyance which it causes will depend upon its frequency occurrence. A frequency of about one such flicker per hour during the main period of illumination, from sundown to midnight, may not be objectionable. The 4% dip in illumination will be barely perceptible and will go unnoticed by most observers.)

Voltage Drops for Various Loads

Load	Voltage Drops					
	Secondary Main		Secondary Transformer		Transformer Plus Main	
	Volts	%	Volts	%	Volts	%
Distributed Load Only	5.21	2.26	3.93	1.71	9.14	3.97
Motor Running Load Only	1.99	0.87	0.46	0.20	2.45	1.07
Motor Starting Load Only	8.49	3.69	2.92	1.27	11.41	4.96
Dist. Load + Mot. Run. Load	7.20	3.13	4.39	1.91	11.59	5.04
Dist. Load + Mot. Start. Load	13.70	5.95	6.85	2.98	20.55	8.93

Example 7—Underground Secondary Distribution Main with Uniformly Distributed Load

Problem: An underground 3-wire, single-phase secondary main of No. 2/0 copper operates at 115/230 volts. The average spacing, center to center, of the two "hot" wires is 1.4 in. It serves a distributed load of approximately uniform density of 50 kw. per 1,000 ft. at 90% lagging power factor. The main consists of two sections, one on each side of its distribution transformer and extending in different directions. The two sections are of unequal length. The longer section extends 500 ft. from the transformer. What is the maximum voltage drop of the secondary main?

Solution: The maximum voltage drop of the main will, of course, occur at the end of the longer 500-ft. section.

It is assumed that load unbalance between "hot" wires and neutral is too slight to have any appreciable effect on voltage drop.

The total load of the 500-ft. section is 50 (500/1000) = 25 kw.

Voltage drop of any line is directly proportional to the integrated product of its load and distance. The voltage drop of this section is proportional to (25) × (500)/2 = 6250 kw.-ft. and is the same as that which would be produced by a single concentrated load of (6,250/500) = 12.5 kw. at 500. ft.

The current of the *equivalent* concentrated load is 60.39 amp.

With a straight edge at No. 2/0 copper on the GMR scale of the nomograph and at 0.117 ft. (1.4 in.) on the Spacing-of-Conductors scale, read on the Reactance scale 0.267 ohm reactance per mile of one conductor.

With the straight edge at 0.267 ohm on the Reactance scale of the nomograph and at No. 2/0 copper on the Resistance scale for lagging power factors, read 0.547 volt drop along one mile of one conductor carrying a load of one ampere at 90% power factor.

Maximum voltage drop of secondary main = (0.547 volt) × (2 wires) × (500 ft./5,280 ft.) × (60.39 amp.) = 6.26 volts.

Percent maximum voltage drop of secondary main = 100(6.26)/230 = 2.72%.

Electric Heating in Portland Homes

Limited experience with thermostatically controlled individual room space heaters lends encouragement to the cause of electric house heating in the Pacific Northwest

INITIAL PURCHASE some years ago of firm power from the large Federal projects at Grand Coulee and Bonneville by the Portland (Ore.) General Electric Co., prompted A. C. McMicken, general sales manager of that company, to a consideration of electric house heating as a possible additional service to residential customers. This together with the adoption in 1939 of an all-service, single-meter rate containing a 900 kw.-hr. block at 7 mills, led the company to encourage a number of builders of new homes to heat them electrically. This was done primarily to get first hand information on the highly controversial subject of electric house heating with electrical energy.

First Installations

Some thirty all-electric homes were built in the Portland area during 1940 and 1941, all being electrically equipped for lighting, cooking, water heating, refrigeration and space heating. Omission of basements and fuel fired heating plants made savings that greatly exceeded the cost of insulating and weatherstripping plus the cost of heaters and heater circuits and their installation.

The belief was that, if confined to four and five room houses, properly insulated and weatherstripped, heating costs under the new rate schedule would not be excessive. In addition to insulation and weatherstripping, the utility required that each heater of 2,000 watts and larger be thermostatically controlled to hold down demand and increase diversity, and insofar as possible prevent waste of electricity and consequent customer complaints.

In addition to the 30 odd homes mentioned, there have been built during the war several FHA approved apartment courts consisting of four, four-room apartments in each. Projects of this type, containing more than 100 electrically equipped apartments were built during 1943 and the first half of 1944. All were properly insulated and fully equipped with electric ranges, refrigerators, 30-gal. single-unit water heaters, and each was provided with a 3-kw. space heater in the living room; 2-kw. in bedroom; 2-kw. in kitchen-dinette and 1 or 1.5-kw. in the bathroom. The 2-kw. heaters in bedroom and kitchen are on a double-throw switch so that both cannot be operated at the same time thus limiting the space heater possible load to 6 or 6.5 kw. total for each apartment.

Six such structures containing 24 apartments were first occupied in October, 1943, so that experience is very limited. However, the company has had three or more years in which to observe the all-electric operation of more than 30 private residences, ranging in size from four to seven rooms and in cubical content from 4,400 cu. ft. to 16,000 cu. ft.

Data Obtained

An analysis of 20 of the all-electric homes for the year 1943, consisting of two, three-room; three, four-room; ten, five-room; three, six-room; one, seven-room and one, eight-room; all insulated and weatherstripped, reveals the following average data: Cubic feet, 7,971 each; connected heating load, 15.9 kw. each; total billing for the year for all electric service $166.41 for 15,673 kw.-hr. each; portion chargeable to electric heating, $75.74, and 8,809 kw.-hr.; kw.-hr. per cu. ft. for heating, 1.11; average annual cost per cu. ft., 0.95¢.

One year's operation for four all-electric apartments in one of the courts showed a bill of $116.92 for 10,130 kw.-hr. for one; $116.19 and 10,050 kw.-hr. for another; $99.99 and 8,204 kw.-hr. for a third and $107.28 and 9,040 kw.-hr. for the fourth. For heating only, bills and kilowatt-hours for each were respectively, $47.84, 6,346 kw.-hr.; $45.67, 6,058 kw.-hr.; $40.87, 5,492 kw.-hr., and $49.80, 6,480 kw.-hr. Maximum demand for a similar group of apartment courts containing 28 apartments, was 107.7 kw., and occurred at 10 a.m. on January 22. This is a demand of less than 4 kw. per apartment and on the basis of 8 kw. of heating load connected, the diversity of the group is better than two to one. For larger groups of house heating loads the diversity would probably be greater.

Customers Pleased

The all-electric rate applying to all of the above is as follows: first 50 kw.-hr., 3.5¢; next 75, 2.5¢; next 100, 1.5¢; next 900, 7 mills; over 1,125, 1¢. Minimum charge $0.85.

Checks of occupants of both apartments and homes reveal a high degree of satisfaction and not a single complaint. Regardless of competition with other forms of heating, it is very apparent that many home builders in the Portland area will demand electric heat and will be willing to pay a reasonable premium over other methods of house heating in order to enjoy its convenience and comfort.

Still Inconclusive

It is appreciated that data obtained from this small number of houses and apartments will not be conclusive and will not fully answer the questions in the minds of many as to the desirability of such load. However, it is felt that this experience is a contribution to the controversial subject of electric house heating and that when full data are available on panel heating, heat storage systems and use of the heat pump, in addition to this space heater approach to the problem, then the way may be clear to a sound electric house heating program that will receive general public acceptance and at the same time be profitable to the serving utility.

Editorials

S. B. WILLIAMS, *Editor*

Dewey Fishing for Votes With St. Lawrence Proposal

RECENT NEWSPAPER REPORTS that Governor Dewey proposes to have New York State develop the power resources of the St. Lawrence are not to be taken too seriously. It must be remembered that 1948 is not too far away for presidential aspirants to make overtures, and the western states are very eager to have a waterway for hauling grains to Europe.

While previous New York governors have had legal assurance that the State, by owning the bed of the river, or a portion thereof, could proceed with developments over its own property, its completion would involve cooperation with Canadian authorities and by the Constitution states are enjoined from conducting negotiations directly with foreign governments. This would mean either the Canadian government or the Province of Ontario.

Boundary matters between the two governments are under the jurisdiction of the International Joint Commission. Before proceeding with such a project the State would have to secure the Commission's approval and, in addition, a license from the Federal Power Commission.

The treaty establishing the Joint Commission provides specifically that no obstruction or division of boundary waters can be undertaken without approval of the Commission—a further indication of the improbability that the State could get very far with Dewey's proposals.

Former New York governors Smith and Roosevelt proposed state development of the St. Lawrence when they were angling for the presidential nomination. Apparently Dewey is following a lead that has not hurt his predecessors politically.

Letters from England

FOR THE PAST FIVE YEARS members of the electrical industry have had the pleasure of reading a series of letters from English men and women engaged directly or indirectly in the supply of utility service—gas, telephone and electricity. The first of the year the letters passed 100 in number. It is estimated by Davis M. DeBard, who alone and without compensation has acted as the American end of the correspondence and its dissemination, that these news letters are now read by more than 40,000 people in this country.

To Mr. DeBard and his 26 English correspondents, we who have been privileged to read these letters regularly are deeply indebted—not alone for the intimate information concerning the effect of war upon utilities, information not obtainable in the daily press, but for the opportunity to understand better our fellow allies. We are sure that others felt pretty much the same, that there was something personal about the letters that never is felt in the reading of newspaper accounts. It was the intimacy of understanding that came from these letters that made many of us feel that we knew our English friends better.

Of course, 40,000 readers isn't a lot when comparison is made with a population figure in excess of 130 million but if these letters from England have helped to bind that 40,000 closer to our allies they have been very much worth while.

Some day we hope that a grateful industry will find some appropriate way to express to Mr. DeBard its appreciation for his application to this self-imposed task and the open-handedness with which he shared these letters with all of us.

May Be Just as Well Lighting Exposition Was Postponed

SOME CONSOLATION might be gained by those who were promoting the International Lighting Exposition from the widespread disappointment on the part of those who were planning to attend. Seldom has anything within this industry created so much interest as the proposed exposition.

In postponing the exhibit which was scheduled for April, in accordance with the Byrnes' request, the manufacturers have by no means abandoned the idea. The money received from the exhibitors has been placed in escrow and already plans are being discussed for an even better and more comprehensive show a year from now.

In some ways it is perhaps fortunate that the ban on meetings prevented the opening of the exposition this spring as planned, for it is highly improbable that the manufacturers would have disclosed for benefit of competition their new designs at a time when there could be no market. With little or nothing new to see, those who had traveled great distances would have felt they had been let down and as a result the later real show would have suffered in attendance.

With little or nothing to be gained by holding an exposition at this time the lighting industry may find that the Byrnes' order, in spite of all the hard work and expense that had accumulated, was a blessing. Another year will enable many plans to mature, will

bring more knowledge of the market, and, we hope, will find the sales forces again being built up and ready to go. The exposition planned for this spring, had the time been propitious, would undoubtedly have been good but the show that we will have next spring will be even better.

The Evidence on a Silver Platter

WHY IS IT that the ships of our Navy can roam the Pacific waters far away and long away from their bases, ready to pounce on the Jap wherever he may be found? What is it that gives our task forces the ability to prowl the western island seas for many days more than the ships of any other nation can?

High-pressure, high-temperature steam is the answer to those questions. In that answer, and in all that it includes of blasted, sunken ships of Japan's navy, lies a great tribute from our country to its most persecuted industry. Except to a few, and some of them men of position and importance in the industry concerned, who apparently do not realize its significance or hold it in small regard, that tribute is as yet undisclosed. Certainly the people of the United States do not know, they have not been told, that were it not for the engineering talent and the management courage of the politically slandered and battered private power companies the battles in the open Pacific and in its narrow island waters might well have had far different outcomes. Nor would Admiral Halsey have been able to sink scores of enemy ships along the coast of French Indo China.

There is no intent here to lessen in any way the credit due to Admiral Harold Bowen and other Navy officers, and to William Francis Gibbs, that inspired naval architect, for adapting high-pressure, high-temperature steam to ship propulsion and for persuading the conservative Navy to accept it. Nor is there here any desire to minimize the labor and the genius of the many men in research laboratories and on the design staffs of manufacturers who undertook the job of building boilers to generate and turbines to use steam so hot that the pipes that carry it glow almost cherry red.

No, our purpose here is to point out that Bowen and Gibbs would not have had high-pressure, high-temperature steam to bring to the Navy for ship propulsion if there had not been a courageous and enterprising intermediate agency to take it from the hands of the research men and designers and make it work on land. Some of the credit for our victories in the Pacific must go to men like John Anderson who more than twenty years ago made one of the first 1,500-lb. installations work in the Lakeside plant in Milwaukee, like Alex Dow who put an experimental 1,000-deg. turbine into Detroit Edison's Delray plant, like Philip Sporn with his 2,500-lb. job at Twin Branch.

Definite, unequivocal and authoritative recognition of the essential contribution of the power companies to the supremacy of the United States Navy by their development of high-pressure, high-temperature steam is contained in the last of a series of three articles entitled "The Mysterious Mr. Gibbs," written by Alvah Johnston and recently published in the *Saturday Evening Post*. Here, right to their hands, offered on a silver platter, is evidence that the courage and enterprise of the private power companies have served the nation well beyond the limit of regular duty; evidence that the power companies, in just common-sense self-interest, might well broadcast to the people.

Competitive Consulting

PROGRESSIVE BREAKDOWN of the holding companies seems to be resulting in several consulting firms being asked to submit proposals more or less competitively on prospective jobs of utilities. Some of the consequences can be advantageous, but others may prove to be a potent test of the engineering profession in its consulting categories. Those tests may impinge on the factors of comparative competency, of fair and appropriate fees, of professional engineering ethics.

Competency is demonstrable. It is proven by the record of previous consulting jobs. It hinges on alertness to modern engineering trends, on ability to gear designs to the economic needs of the period and to the peculiar requirements of the local situation. It necessitates a stable staff. In short, it means experience and prestige built on meritorious achievement.

The matter of fees is a difficult one. The low bid for consulting services can, of course, prove to be the most justifiable one to accept. On the other hand, the high bid may prove to be the lowest in the end because the economies in the recommended construction and its subsequent operation can often more than offset the excess in initial charges for the consulting advice and supervision. The client has a duty to the consuming public to make the lowest over-all expenditure compatible with long-term cost and efficiency. This issue of fees puts upon the client the necessity of establishing yardsticks for measuring all these relative items of immediate and ultimate cost. It puts on the consulting firm the necessity of analyzing its own operating costs so as to get the service fee as low as is compatible with doing a wholesome, as well as profitable, job of design and supervision.

The real crux of the ethical aspect is that any pressure to resort to arm's length bargaining by the route of competitive consulting bids shall not break down the codes of ethics which engineering associates have set up; in fact, some firms refuse to enter such "competitions." Instead of affording any advantage, it would jack up the costs of consulting to invite too many considered proposals. In meeting any regulatory aim of keeping industry costs at a minimum it is only necessary to establish the fact of competent competition. Comparatively few flaws are to be found in the practice of the past in which the "patient" stuck largely to his own "doctor".

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

Williams Not Asked How He Would Run REA

THE FIRST twelve and one-half hours of testimony and cross-examination by the Senate Agriculture Committee on the qualifications of Aubrey Williams to be administrator of the Rural Electrification Administration brought a flood of testimony purporting to demonstrate that:

1. Williams is a Communist.
2. Williams is not a Communist.
3. Williams was an incredibly bad administrator of the National Youth Administration.
4. Williams was such a good administrator of NYA and WPA that he is just the man for REA, which needs a good administrator badly.

Testimony has ranged from the almost-hysterial tirade of a deluded "professional" witness notorious among Capitol reporters to a superb exposition of REA's organization and function delivered by Vincent D. Nicholson, a deputy REA administrator whom last year's REA investigating committee refused to hear.

No REA Policy Questions

At this writing, hardly a word of testimony has been heard from Mr. Williams—nor asked of him—relative such meatier REA matters as:

1. The legality and/or wisdom of REA's policy on acquisition of existing electric power facilities.
2. The legality and wisdom of the increasing emphasis placed by REA on co-op service to and development of non-farm and non-rural-dwelling loads.
3. The legality and wisdom of diverting money appropriated to bring service to farmers to such purposes as a cooperative pole-treating plant, for which REA recently allotted $200,000 to several Texas co-ops.
4. How and why REA ever got far enough off the beam to go along with experiments in perpetual motion and to finance a rural generating system at a cost of $523.50 per kilowatt.
5. What should be REA's working policy with respect to the National Rural Electric Cooperative Association.

It is not Williams' fault that the testimony—up to this writing—is so overwhelmingly devoted to his political, social and economic beliefs. Nor is the Senate Agriculture Committee to be unequivocally damned for considering the matter of Communism and Aubrey Williams. Certainly if Williams be a Communist, he is no man for any non-elective government job, let alone the directorship of a corporation which stands to have more than a billion dollars for investment in American agriculture.

Since the first two of the questions which the Committee failed to consider—REA's acquisition policy and its emphasis on non-farm load development—are raised principally by the privately-owned portion of the electric power industry, most of whatever blame is forthcoming hereunder must rest on the private power industry. As far as REA is concerned, it has the authority for these policies. A move to halt acquisitions was decisively beaten on the House floor during the 78th Congress. The industry remains almost the sole objector to the acquisition policy, and having discarded this opportunity to put up, must, in any grace, shut up.

Diversion of Funds

As for the diversion of funds from lines to serve farmers into projects which do not serve farmers, responsibility for the investigation of this matter is up to individual members of Congress, some of whom occasionally do a little with it. Apparently no farm organization felt strongly enough about it to insist that it be discussed, but the feeling persists that it is a more vital issue than what Williams meant when he told a depression-era audience of reliefers to "keep your friends in power."

One of the more unfortunate aspects of the Committee's conduct of the hearings is its lack of acquaintance with and disregard for the testimony taken last year by the REA investigating committee. While the record compiled last year is a sorry one in many ways, it points a finger at past performances by REA which should be guarded against in the future, and there are few more basic ways to guard against them in the future than in getting the new administrator firmly on record regarding them.

Where Does He Stand

It is to be presumed that Williams has no belief in the possibilities of perpetual motion, but two earlier REA administrators did suffer the expenditure of tax revenues on perpetual motion development. Thus, Williams would hardly be oppressed were he required to swear his disapproval of such nonsense as vigorously as he was invited to disavow belief in Communism. And those Senators who charged extravagance in the conduct of NYA, now defunct, could with equal point and more timeliness have pinned Williams down to a repudiation of any engineering philosophy which would allow farmers to be loaded with the ridiculous burden of a power station which cost $523.50 per kilowatt. Both of these performances are attested in the transcript of last year's hearings which were conducted exclusively by such champions of REA as Sens. George D. Aiken and Henrik Shipstead.

The committee did ask about and Williams did repudiate politics in REA, but the discussion failed to touch on the allegedly political relations between REA and NRECA, which a string of witnesses in last year's investigation deplored. If NRECA has made a political football of REA, the committee could have done Williams a real favor by forcing him, as a condition of getting the job, to go squarely on the record against any contact between the two groups which could have political implications or repercussions.

Instead, it just asked Williams if he were a Communist.

NEWS OF THE WEEK

Bills Affecting Utilities Up for Congressional Action

Passage of Senate-Approved Rivers-Harbors Bill by House Likely—Representative Carlson Would Tax Bonds of Public Power Projects—Senator Byrd Would Put Government Corporations under Congress

The Senate-approved Rivers and Harbors bill was on its way to the House floor this week, cleared of controversial projects which could have tied it up for weeks of debate. Little prospects of delay in its approval by the House or by the President thereafter was seen.

Meanwhile, the House approved and sent to the Senate the Independent Offices bill appropriating funds for the Federal Power Commission, the Securities and Exchange Commission and the Tennessee Valley Authority for the fiscal year beginning next July 1. Only floor fight on the bill was on the appropriation for another agency.

The House Ways and Means Committee, meanwhile, received a resolution introduced by Rep. Frank Carlson, Kansas Republican, which would amend the Internal Revenue Code so as to prohibit exemption from taxes of interest on bonds issued to finance the public acquisition of existing utility properties or the public construction of new utility properties where such bonds were not backed by the treasury of the issuing public agency.

Carlson described his resolution as designed to break up "a giant tax evasion racket," wherein public ownership of utilities was used as the basis for tax-free investment returns but where the securities actually were held by private investors and public ownership existed only in name.

Senator Harry F. Byrd, Virginia Democrat, moved in on government-owned corporations, including the Tennessee Valley Authority, with a bill which broadly extends the control of Congress over such agencies.

Under the bill, these corporations would have to submit annual budgets and operating programs to the Budget Bureau, for later submission to Congress, and would be forbidden to transact any business not authorized for the fiscal year in question by Congress. In addition, the corporations would be audited annually by the General Accounting Office, established years ago by Congress to insure that appropriated funds are spent in rather strict conformity with the Acts in connection with which such funds were appropriated.

Study of the bills introduced last week by Rep. John Rankin, Mississippi Democrat, and Senator Hugh B. Mitchell, Washington Democrat, to establish respectively nine regional conservation authorities and a Columbia Valley Authority, indicates that each bill, if it became law, would give the resulting organizations all the powers of the Tennessee Valley Authority with respect to the generation and sale of electric energy, plus some other authority.

The CVA bill, however, puts the agency under more or less general supervision of a National River Basin Development Board, which would be headed by the Secretary of the Interior. CVA would have two years in which to present a broad plan for development of the Columbia watershed, which would be approved if Congress failed to reject it within several months after its submission. In addition to the customary authority to build, acquire and condemn existing facilities of use to its power or other programs, CVA would get Bonneville and Grand Coulee dams and the Bonneville Power Administration transmission grid, in addition to jurisdiction over Hungry Horse Dam in Montana, which has been authorized but not built.

Could Sell to Individuals

It could make interchange contracts, market power with the customary preference to public bodies, allow public bodies time to organize for acquisition of existing facilities before selling power to private companies, sell directly to individuals, dictate resale rates in contracts with private electric companies, and cancel contracts with private companies on three years notice to fulfill the public preferences.

CVA could build systems for existing or potential purchasers, help people organize cooperative or municipal systems, lend money for acquisitions to such public agencies, and could buy existing systems to hold for later resale to coops, municipals, power districts and similar organizations. As with TVA, and CVA would pay its operating expenses from operating revenues, as well as interest and amortization payments and payments to a contingency fund. It would make payments in lieu of local taxes.

The Rankin bill would give the nine "conservation" authorities, which would blanket the U. S., all the authority of the TVA or CVA bills and then some, and would call for broad regional de-

Use of Water Power Causes N. Y. Exemptions

It was incorrectly stated in ELECTRICAL WORLD, February 3, Page 84, that the exemption from provisions of Order U-9 of a small portion of the New York State Electric & Gas Corp. was based on the fact that energy savings realizeable in the area would have been trifling and could not have been used. The exemption was based on the fact that energy consumed in this section of the New York State system is 100 percent hydroelectric, as was the case in the exemptions granted the Paul Smith's Electric Light, Power & Railroad Co., Saranac Lake, N. Y., and the Plattsburg Municipal System.

velopment plans from each authority. Each authority could, when it concluded that rural communities and farmers were not getting service at reasonable rates, serve such consumers directly. Power contracts with private companies could be cancelled on two years notice, and penstocks and other non-operating power facilities would be required of installation in every dam unless the builder could convince the President that they would be useless.

The Rankin bill would prevent any court from enjoining any operation under the act unless there were posted sufficient bond to cover all posible damages which might even be demonstrated, including loss of potential power revenue not only by the generating authority but by any agency which might be organized to sell such power.

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Electric Motor Production Remains Critical Problem

WPB is having trouble with production of both fractional and integral horsepower electric motors, but for different reasons.

December production of fractional horsepower motors was down from that of the preceding month, and manufacturers have been working off their backlogs as new orders for aircraft and other types of military motors were slow in coming in, WPB explained. This resulted in delayed placing of orders by motor manufacturers for components and materials. The military is speeding up placement of orders for these motors in order to avoid loss of production.

For the next six to nine months, production of integral horsepower motors will be as urgent as at any time in the last two years, according to manufacturers. Several top urgency programs involving much electrical equipment have been started or expanded in the last six weeks, with substantial portions of this equipment sought by April.

Among the programs which have boosted the demand for this equipment are the mortar and medium ammunition program involving about 6,000 machine tools and the heavy tire program. In addition, the Navy Department has indicated that its 1945 electric equipment requirements will be at least equal to those of 1944.

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City Declares 20% Dividend

Fergus Falls (Minn.) Light Department has declared a 20 percent dividend to all consumers based upon total electric consumption for the past twelve months. In previous years the dividend has been but 10 percent.

Arkansas Power Co. Hearing Postponed

FPC Sets May 22 as New Date—Special Attorneys Appointed to Protect State and Board

Federal Power Commission has postponed until May 22 a hearing which had been scheduled for February 20 in Washington by the bureau for the Arkansas Power & Light Co. to show cause why it should not reclassify its accounts in accordance with the FPC uniform system of accounts.

The utility asked postponement of the hearing or transfer of it to Arkansas in order to conserve manpower and transportation for the war effort.

Prior to action by FPC postponing the hearing, numerous developments had occurred which indicated that the hearing would take on national significance. First A. P. & L. filed suit in Washington, D. C. Federal Court asking that a three-judge special court be appointed to settle the question of jurisdiction of the utility's books of record. The suit alleged that FPC is attempting unlawfully to make A. P. & L. violate orders of the Arkansas Department of Public Utilities which it already has carried out.

McCulloch to Represent D.P.U.

The next action came when the Arkansas D.P.U. employed R. R. McCulloch, its former special counsel, to represent the department at the hearing to protest FPC's attempt to assume jurisdiction over the utility records.

Then Atttorney General Guy Williams of Arkansas appointed former Governor Carl E. Bailey of Arkansas to represent the state itself at the hearing to support the Arkansas D.P.U. In the meantime several other state regulatory commissions informed the Arkansas D.P.U. they planned to intervene in behalf of the Arkansas department. And the National Association of Railroad and Utilities Commissioners notified Arkansas D.P.U. it would assist in any way possible in defending the state's position.

And Governor Ben Laney of Arkansas said in a public statement that the question of "States rights" is one that the state should and would support fully.

In appointing former Governor Bailey as special assistant attorney general, Attorney General Williams said:

"This proceeding will involve the power of all state commissioners; therefore it is my duty to intervene in the state's interests. Already too many roads lead to Washington, and further Federal encroachment is on the march. Certainly the primary books of any corporation organized in this state and receiving its right to do business from the sovereign, must be controlled by the authority conferred by our state legislature. Otherwise, the Arkansas legislature, for all practical purposes, will be indefinitely adjourned by decree of the Federal Power Commission."

C. Hamilton Moses, president of Arkansas Power & Light Co., said his company was preparing to proceed to Washington for the hearing at the time notice was received of the postponement. About 25 employes "and a truck load of records" were being prepared for participation, he said.

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Oregon May Act to Limit P.U.D.'s to Own Territory

Tightening of the Oregon Public Utility District code to prevent districts from engaging in power operations outside their own territory without advance consent of voters in areas to be served has been proposed in the state's 1945 legislature.

Designed to plug a code loophole which late in 1943 threatened to place the rural Hood River P.U.D. in control of all major electric systems serving Oregon, the bill duplicates one introduced in the last legislature too late for action.

Power interests in the state were moved to seek legislative control of the P.U.D. code when members of Hood River P.U.D., composed of rural sections of Hood River County, balloted in January, 1944, on a proposed $175,000,000 revenue bond to negotiate acquisition of private power companies in Portland and other areas.

Though the particular plan was defeated by a small majortity, it served to illustrate the loophole which would allow districts to control power and rates outside their territory, since there is no state regulation of P.U.D. services. The proposed law change would eliminate such surprise actions, it was reported.

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Generator a Replacement

It was incorrectly stated in ELECTRICAL WORLD, January 20, page 125, that a 45,000-kw., steam turbo-generator has been approved for the South Meadow plant of the Hartford (Conn.) Electric Light Co. The company received a priority from the Office of War Utilities for a new 45,000-kw. generator only, to replace a 40,000-kw. generator now installed. Neither a new boiler nor a new turbine is to be installed; therefore there is no increase in area capacity.

Commission Attacks FPC Attitude in Montana Case

Chairman Middleton Sends Memorandum to All Other State Regulatory Boards to Apprise Them of Treatment Accorded His Group in Montana Power Co. Hearings—Incident Is Third Attack on FPC in Month

For the third time in less than a month, the Federal Power Commission has been attacked by a state regulatory commission for exceeding its powers and interfering with "states rights.'" Montana Board of Railroad Commissioners has addressed a memorandum to to the commissions of all other states to apprise them of the conduct of the PFC in the case of Montana Power Co.

Milo R. Maltbie, chairman of the New York Public Service Commission, recently charged FPC with attempting "to usurp power over intrastate commerce" in informing three New York natural gas companies that they were governed by the National Gas Act (ELECTRICAL WORLD, January 20, Page 124).

In Arkansas, the Arkansas Power & Light Co. has gone into Federal Court to find out whether FPC or the state commission has jurisdiction over its books (ELECTRICAL WORLD, February 3, page 95).

Explaining that it had just completed a concurrent proceeding with the FPC involving a reclassification of accounts case against the Montana Power Co., the Montana commission stated that the memorandum had been prepared in the belief that other State commissions should be apprised of developments in the case which was completed recently.

The FPC late in 1943 ordered Montana Power to write off some $54,000,000 from its accounts, and the Montana commission, under a cooperative agreement which the National Association of Railroad and Utilities Commissioners has with the FPC, joined in the proceedings.

Treatment accorded the Montana commission by the FPC was anything but satisfactory, according to the memodandum, which outlined developments as follows:

"We were ignored (by the FPC) at every point of the road and had to continually fight for our State's rights. In all discussions we were treated cordially and were urged to continue the cooperative proceedings, but every time there was a problem to be decided there was no possibility of any cooperation unless we would fully agree with the views of the Federal Power Commission, regardless of what the facts were in the case."

Extending over seven weeks, the hearing was conducted in a "most unusual manner", according to the memorandum, which was signed by Austin B. Middleton, chairman of the Montana commission.

"Federal Power Commission counsel was allowed to introduce volumes of irrelevant evidence by the examiner," the statement runs. "The Montant Power Co., when it tried to introduce evidence we thought was admissible, was told by the examiner that it would not hear such evidence. Our State commission, however, did hear that evidence, as we thought it was admissible and important in properly hearing the case. The FPC's attitude at all times, both at the hearing and in meetings, was plain—and that was that they wanted to write off $54,000,000, no matter what the facts showed."

Declaring that attorneys for the FPC prevented even the possibility of a compromise with the utility when a compromise of differences apparently was possible, the memorandum concluded that the attitude of the FPC, as shown throughout the proceedings, was one aimed at taking over jurisdiction and regulation which for decades had been exercised by State regulatory agencies.

LARGEST BOND BUYER—Herman Pilger, a mechanic at the Ashley Street Plant of the Union Electric Co. of Missouri, was the largest individual buyer of war bonds among company employees during the Sixth War Loan Drive. Mr. Pilger, who retired on January 1 at the age of 71, is shown with James E. Dumphy, right, pipe fitter and war bond solicitor, signing the papers to purchase a $10,000 bond

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OPA Investigating to Halt Increase of Lamp Prices

An enforcement drive to halt price increases of household lamps and lamp shades is being conducted by the Office of Price Administration and will continue until March 31.

All types of distributors—manufacturers, jobbers and retailers—will be checked for compliance with price regulations, OPA said. In some cases, retail prices of lamps and shades are two or three times what they were during the March, 1942, base period. Many retailers report that suppliers are quoting prices as high as those retail stores are legally entitled to charge their own customers.

The purpose of the drive is not only to roll back inflated prices but also to protect against unfair competition the large number of manufacturers, jobbers and retailers who are living up to OPA regulations.

Wherever a manufacturer, jobber or retailer is found to be selling at above-ceiling prices. OPA will assert its claim for treble damages and will ask for an injunction restraining the seller from further violations. If a seller cannot produce the required records showing how he established his maximum prices, an injunction will be sought to suspend further sales until he prepares the records and obtains OPA's approval for the price of his products.

Sellers in general will be checked for compliance with record-keeping, reporting and pricing requirements.

Manufacturers in particular will be investigated to determine whether, in sales to jobbers, they are giving the required discounts.

Interior Dept. Has Hetch Hetchy Plan

Government Would Suspend Raker Act If San Francisco Would Buy Pacific Gas & Electric Co.

New attempts by the Interior Department to promote municipal ownership of San Francisco's electric distribution system were made by Under Secretary Abe Fortas in recent negotiations aimed at bringing the city into compliance with the Raker Act, which forbids distribution of power generated at the city's Hetch Hetchy plant by any private agency.

Fortas proposed to Mayor Roger Lapham that he put on the municipal ballot next fall a double-barreled policy declaration under which the city would ask Congress to suspend for five or six years the Raker Act's prohibition of the private sale of Hetch Hetchy energy, and under which voters would approve municipal purchase of the Pacific Gas & Electric Co.'s city distribution properties. After such approval, the city would, at a subsequent election, place on the ballot the question of approval of a bond issue for acquisition of the properties.

Injunction Effective March 1

Mayor Lapham would be expected to "campaign actively" not only on behalf of the policy declaration but also on behalf of the bond issue. Fortas said that if Lapham would agree to the proposals and to campaign for them, Interior would ask Federal Judge Michael J. Roche for a further stay of the injunction which becomes effective March 1, prohibiting further sale by P.G.&E. of city-generated energy.

Without a promise of active support for both proposals, Fortas told Lapham, Interior would hold to its declaration of last summer when it announced that it would not support any further stay of injunction before Judge Roche.

Lapham agreed to place the policy declaration on the ballot next fall and to campaign for it, but he declared that he could not be bound to support actively the proposal for a bond issue. He pointed out that the city plans sizeable postwar expenditures for airport development, traction improvements and betterment of the city's water supply.

San Francisco voters have defeated proposals for city purchase of P.G.&E. properties on nine occasions. In about half a dozen of these elections, Interior Secretary Harold L. Ickes has led the fight for municipalization.

Fortas said that in view of Lapham's refusal to commit himself now, the next move was up to the city. Unless some substitute is worked out by the end of the month, Hetch Hetchy output will have to be cut appreciably. Interior approved sale of some Hetch Hetchy power to two irrigation districts, Modesto and Turlock, and the use of additional energy by the city for its own purposes, this power to be moved from Newark substation to the city by P.G.&E. on a common carrier basis. Interior refused to approve the third part of the city's plan, under which P.G.&E. would have marketed the energy unused by the irrigation districts and the city.

Lapham pointed out that in about five years, the city and district loads will have grown to a point at which all Hetch Hetchy capacity will be needed on peak, but Fortas replied that at no time during the nine-year life of the irrigation district contracts would anticipated load growth account for all Hetch Hetchy's possible output, which was 525,000,000-kw.-hr. in 1943.

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Ogden Gets Conservation Post in Power Division

C. F. Ogden, assistant purchasing agent for the Detroit Edison Co., has been named chief of the Conservation Branch of the Office of War Utilities' Power Division. The Conservation Branch administers order U-9.

Ogden, on loan for an indeterminate period, replaces William A. Lyons, who returned to his position as assistant to the president of the New York State Electric and Gas Corp. last week.

Ogden assisted C. E. Kohlhepp, vice-president and general manager of the Wisconsin Public Service Corp., early in 1943 when the latter organized OWU's Inventory Control Branch.

Conservation branch consultants include Charles A. Collier, vice-president of the Georgia Power Co., and Harry I. Miller, former chief of the Inventory Control Branch, who returned last year to the Wisconsin Public Service Corp.

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Northern Ontario Power to Cash Preferred Stock

Northern Ontario Power Co., Ltd., will redeem its 6 percent cumulative preferred stock on March 31, at 110 plus accrued and unpaid dividends, in Canadian funds, to date of redemption, less income tax deductible at the source. Up to 15 days before the redemption date, stockholders have the privilege of converting any number of shares into common shares without nominal or par value at the rate of one preferred for two common shares.

Pioneers Arranging for Edison Centennial

Plans for the celebration of the centennial of the birth of Thomas A. Edison were advanced last Saturday at the twenty-seventh annual meeting of the Edison Pioneers, an association of men who were identified with Edison in his work of invention and experimentation, in New York.

Charles Edison, son of the inventor and president of the Pioneers, has been

THE EDISONS—Mrs. Thomas A. Edison, left, her daughter, Mrs. John E. Sloane; and Charles Edison

empowered by the executive committee to name from within and without the membership body men and women to serve on the Thomas A. Edison Centennial Committee. The celebration will be held on February 11, 1947.

Samuel B. Williams, editor of ELECTRICAL WORLD and president of the Illuminating Engineering Society, spoke of the necessity for relighting America in the next ten years. He told how Edison with his invention of the incandescent lamp first relighted America, how the substitution of the tungsten for the carbon filament led to a second relighting period, and how recent improvements of lighting together with a better knowledge of proper illumination demand that America be relighted once more to better vision and for the comfort, safety, and happiness of the people.

All officers of the Pioneers were reelected. They are Charles Edison, president; W. W. Freeman, J. Parker Hickman, Walter E. Kruesi, and Montgomery Waddell, vice-presidents; Eugene C. Reed, secretary; A. L. Holme, treasurer; and John C. Coakley, historian.

Successful Utility Wartime Record Due to Engineers

Duquesne Light Co. Engineering Manager Tells P.E.A. Equipment Group of Value of Committee Deliberations—Problems of Maximum Wartime Output and Reliability as Furthered by Tests Discussed

Basis for the undeniably successful wartime performance of electric utility systems was established in the deliberations of engineering committees of industry associations prior to and during the war, said Arthur G. Butler, manager of engineering and construction, Duquesne Light Co., at the Thursday luncheon of the two-day meeting of the P.E.A. electrical equipment committee in Pittsburgh, February 8 and 9. Fullest utilization of the limited facilities would never have been achieved without such interchange of experiences and analyses. The sessions were attended by 38 from the Pittsburgh area and 17 from companies to the eastward.

Maintenance testing of insulation in high voltage equipment was one instance of Butler's theme. E. R. Whitehead of the same company told how progressive extension of such testing, along with lightning-prevention measures, had reduced breaker bushing failures from 3.75 average per year in 1923-28 to only one in the whole six-year period 1938-43. That one failure was attributed to neglect to remove a bushing tagged for replacement on the criteria of tests which now include dissipation factor (including the Faucett collar technique), capacitance and stress distribution. Solid porcelain needs few, if any, such tests but Whitehead would not concede that for the condenser types. There is need of better contacts for the shields and of a wax (silicone liquid was suggested in Moses' later talk) to minimize surface leakage.

"Bare-Bones" Plant Precluded

Local factors of site, water, fuel and duty probably preclude a universal "bare-bones" power plant, said J. S. Brown, Duquesne Light Co., but the cost of the electrical system for a minimal plant can be nearly a third less than for a conventional one if such things as duplicate auxiliaries and supplies are omitted; non-standard short-circuit ratio for the assumed 75 mva. generator may entail $21,000; three-phase outgoing-line transformers could save some $60,000, etc. Discussion brought out that one-ampere current transformers deserve more recognition.

Portraying the evolution of switchboard practice, C. P. West, Westinghouse Electric & Manufacturing Co., intimated that modern treated wood might be proven in for low-voltage panels but doubted that aluminum would prevail because of strength factors or that miniatures are more than infrequently justifiable. He exhibited a new relay test-block and saw merit in Brown's removable-unit panel scheme. Swinging synchronizing panels were dubbed "skull-crushers" by R. E. Neidig, Metropolitan Edison Co., in the extended discussion. K. E. Riordan, West Penn Power Co. favored insulating covers for rear panels and the money-saving gutters.

Survival of motors and generators insulated with siliconed HGS materials after unheard-of loading and short-circuiting temperatures as recited by G. L. Moses, Westinghouse Electric & Manufacturing Co., brought murmurs of consternation from the audience. He called the new largely inorganic impregnant the answer to the all-important thermal aging of insulation and said studies were in progress to develop the bearings and magnetic materials needed to grant it its logical, if still somewhat limited, place.

Silver plating is neither a panacea nor a vitamin for contact troubles, but it can lick the oxidation problem, said H. H. Rudd, vice-president of Railway & Industrial Engineering, in a comprehensive presentation. He favors using a torque wrench on bolts but doubts the efficacy of spring washers on buses.

At the Friday luncheon A. E. Knowlton showed a sound-slide that portrays how ELECTRICAL WORLD readers are helping to improve the effectiveness of equipment advertising.

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Alfred C. Marshall Dies

Alfred C. Marshall, director, consultant and chairman of the operating council of the Detroit Edison Co., died on February 9 at Harper Hospital in that city following a short illness. His death was caused by an injury received from a fall which occurred on January 28. Last May, Mr. Marshall retired as president of Detroit Edison, the position he had held since 1940. He was 72 years of age.

Salem Voters Deny Franchise to Co-op

Victory in Oregon Capital Would Have Made Co-op Rival of Portland General Electric Co.

The long and bitter struggle between private owned power companies and cooperative groups of the Pacific Northwest reached a new climax, February 9, when residents of Salem, Ore., rejected by a vote of 2,366 to 2,283, with but 30 percent of eligible voters going to the polls, an application of the Salem Electric Cooperative Association for a 10-year franchise.

Significance of the election outcome in Oregon's state capital was rooted in the fact that the area has long been served by the Portland General Electric Co., and had the franchise been authorized it would have served as a precedent for other cooperatives in Washington and Oregon to seek permission to establish duplicating facilities in communities already served by established utilities.

Set Poles at Night

The Salem Electric Cooperative was formed July 23, 1938, its organizers being an electrician, a jeweler, a clothing merchant, a meat merchant, a clerk and a skating rink operator. Nearly two years elapsed before it gained more than cursory attention. Then, at night and over the week-end of June 1 and 2, 1940, the co-op emerged from obscurity and set seven poles inside the city's boundaries. Subsequently, additional poles were set in the city, but upon protest from city officials, construction was stopped. On July 1, 1940, Salem's Common Council granted the cooperative permission to set twenty poles, including those already set.

A Citizens' Committee of fifteen appointed by Salem's mayor to study the city's power problem rendered a report against allowing the co-op to establish a service that would duplicate that already rendered by P.G.E. In submitting its report, the Committee cited authorities, including Dr. Paul Raver, Bonneville Administrator, to the effect that "duplication of electric power facilities in any community should be avoided at all times because it is an economic waste and usually results in increased costs of distribution . . . and, in turn, higher rates to consumers".

But, despite strenuous opposition on the part of President James H. Polhemus of P.G.E. and civic groups, in February, 1942, co-op workmen began installing a lead-covered cable across the Salem-West Salem bridge spanning the Willamette River. On March of that

year, the lines strung on the 20 poles erected two years before carried power for the first time.

The following November the co-op announced a rate cut to consumers, but in January, 1943, the old rate was restored following a flood in the Willamette which broke the feeder lines from Bonneville.

Both P.G.E. and the co-op obtain their power from Bonneville and P.G.E.'s President Polhemus, in resisting the move to duplicate the company's service, pointed out that while P.G.E. took delivery of 20,058,000 kw.-hr., in 1944, the Salem Electric Cooperative took delivery of only 246,720 kw.-hr. for the same period.

Replying to charges from the co-op that the P.G.E.'s rates were 188 percent higher than its own, Mr. Polhemus submitted a report in which he contended his company's rates are the lowest in the nation, including those charged by the cooperative. Comparative statements for the year ended June 30, 1944, he declared, show that P.G.E.'s Salem customers paid on home use an average of 1.38¢ per kw.-hr., while co-op customers paid an average of 1.56¢ per kw.-hr.

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New Jersey Utilities Have Ample Post-War Capacity

No deficiency is seen by the New Jersey Board of Public Utility Commissioners in plant capacities of electric utilities in the state during the post-war period.

"Fears at the beginning of the war that utilities would be short of capacity to meet emergency demands did not generally materialize," declares the annual report of the board for 1944 to Governor Walter E. Edge. "Plant capacities of electric utilities in New Jersey were employed to the fullest extent, but no serious shortage developed. It now seems clear there will be no deficiency of plant capacity to meet post-war needs."

Savings during the year of $5,605,542 to electric customers through rate adjustments are noted in the report, which listed $5,317,800 going to consumers of the Public Service Electric & Gas Co., $247,542 to customers of the New Jersey Power & Light Co. and $41,000 to those of the Atlantic City Electric Co.

Interruptions of all types of customer services during the September hurricane totaled 505,384, according to the board, which estimated the cost to the companies of restoring normal operating conditions at approximately $1,460,000.

Senate Hearings Continue on Williams Confirmation

Senator Shipstead May Move That Committee Defer Action on Nominee for Administrator until Action Is Taken on Making REA Free—Senator McKellar Favorable to REA Control by Three-Man Board

Senate hearings on the confirmation of Aubrey Williams as administrator of the Rural Electrification Administration have gone into their second week as the proponents of independence for the agency won another supporter who is normally in the administration camp.

After four days of hearings last week, by far the greatest part of which were devoted to attacks on Williams for alleged communistic leanings, Williams was to be recalled to the stand last Wednesday to answer the communism charges, which he denied categorically on the opening day.

It was anticipated that Senator Henrik Shipstead, Minnesota Republican and author of the first REA-Independence Bill this session, would take up the fight for independence with the suggestion that the committee defer action on Williams until it could act on the proposal to remove the agency from agriculture department jurisdiction.

Shipstead, who distributed a statement calling for independence and asserting that "it is impossible for anyone to do a good job (as REA administrator) until this agency is made an independent branch of government . . ." was reported to be considering the possibility of establishing a three-man board to administer REA. Senator Kenneth McKellar, Tennessee Democrat, who led the attack on Williams, said he "would be inclined to support" legislation putting a three-man board at the head of the $525,000,000 agency whose supporters are endeavoring to obtain another $585,000,000 for its post-war program.

Possibility that some sort of agreement whereby the administration would not oppose independence so vigorously as it has in the past was seen in the introduction by Rep. Stephen Pace, Georgia Democrat, of a bill to free REA of agriculture control. Pace, normally an administration supporter, sponsored the measure passed last session which removed the 1946 limitation on REA's loan authorizations, extended repayment to 35 years and lowered interest rates on REA loans to two percent.

His measure went somewhat farther than other REA-Independence bills in that it established qualifications for an administrator. To be eligible for the administratorship under the Pace Bill, a candidate would have to have 10 years experience in business management; five years experience in the operation of a cooperative or of a financial program similar to REA, and "some experience in electric power construction and operation." Williams, under such criteria might qualify under the second stipulation but would not qualify under the first or third.

May Recall Carmody

The possibility was seen in some quarters that these criteria might have been aimed at forcing the recall of former administrator John Carmody, who despite membership on the Maritime Commission, is favored for the REA directorship by some co-ops and by proponents of REA's independence.

In his statement, Shipstead called on the committee to recognize the findings of the agriculture sub-committee which last year spent seven months poring over REA records to turn up with a unanimous recommendation for independence. Shipstead pointed to the 1944 hearings as demonstrating that REA prospered as an independent agency and faded into factional strife under the Agricultural Department. He asserted that "the record shows there is a scandalous condition in REA that exists today and has existed ever since Mr. Wickard (Agriculture Secretary) placed Mr. Neal (Deputy REA Administrator) out there in St. Louis." Shipstead charged that Neal "has been placed out there illegally."

Shipstead's drive for independence for REA got no comfort from the testimony of Vincent D. Nicholson, Deputy REA Administrator, who told the committee that independence would make little difference to REA.

MEETINGS

Previously Listed

Canadian Electrical Association — Annual western conference, Hotel Vancouver, Vancouver, B. C., March 14-16. B. C. Fairchild, managing director, 704 Tramways Bldg., Montreal 1, Que.

Electrochemical Society — Spring meeting, Hotel Claridge, Atlantic City, N. J., April 12-14. Colin G. Fink, secretary, Columbia University, 3000 Broadway, New York 27, N. Y.

OWU Tightens U-9 Reducing Lighting

The Office of War Utilities has tightened Order U-9 to prohibit the use of electricity for advertising, promotional decorative, ornamental and sign lighting in such public passageways as arcades, transportation terminals, subways and lobbies.

The ruling was issued in Amendment I to U-9, which also allows consumer appeals to be made on Form WPB-4113, and which allows utilities which know that a violator has been warned informally by some other compliance agent, such as a WPB field representative or a local policeman, to issue the formal notice of violation without itself giving informal notice.

Meanwhile, OWU granted several more exemptions from U-9, including the following:

Portions of Cimmaron, Tex., and Beaver Counties, Okla., and that portion of Morton County, Kans., all of which are served by the Southwestern Public Service Co. These exemptions are based on the fact that the remainder of the Southwestern Public Service System had been exempted.

City of Walnut, Kansas, served by the Walnut Gas & Electric Co.

The cities of Rouses Point and Copenhagen, New York, both served by hydro-electric energy, the former a municipal plant, the latter served by the Deep River Power Co.

The City of Ketchikan, Alaska, served by Ketchikan Public Utilities, which operates a hydro system.

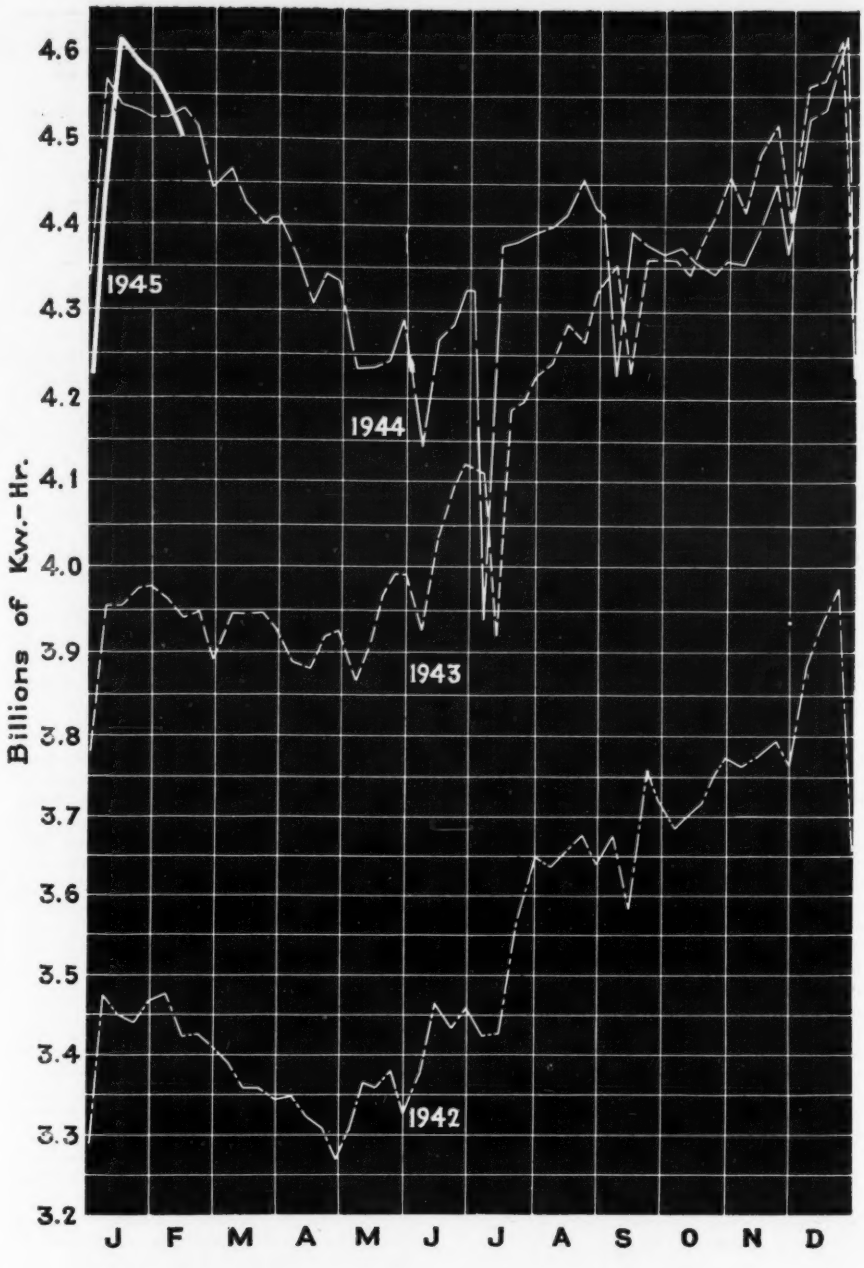
The City of Yazoo City, Miss., served by the Yazoo Public Service Commission whose energy is gas-generated.

The cities of Hill, Rapid City, Lead, Deadwood, Spearfish, Sturgis, Belle Fourche, Newell, Custer, South Dakota, and adjacent areas served by the Black Hills Light & Power Co., whose energy is hydro-electric.

Omitted inadvertently from its last previous list of exemptions by OWU was that portion of Hildalgo County, New Mexico, which is served by the Lordsburg Division of the Community Public Service Co.

Derby Line, Vermont, Radisson, Wis., and Buffalo, Wyo., also were exempted.

In Washington, OWU sent telegrams to about 100 commercial establishments which continued in violation and was about ready to order disconnection of three persistent violators when they complied. Early this week, an OWU spokesman told ELECTRICAL WORLD that OWU had not yet been notified of any actual disconnections in the country, although a number of three-day warnings had been issued.



Electric Output Curve Moves Downward

The electric output curve during the week ended February 10, 1945, moved downward again, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry totaled 4,505,269,000 kw.-hr., compared with 4,538,552,000 kw.-hr. during the preceding week. During the week ended February 12, 1944, energy distributed amounted to 4,532,730,000 kw.-hr., this year's figure representing a decrease of 0.6 percent. The New England group, which reported an increase of 2.3 percent over last year for the week ended February 3, has joined the minus column. The drop in output undoubtedly reflect the effects of the brownout.

Weekly Output Millions Kw.-Hr.

1945		1944		1943	
Feb. 10	4,505	Feb. 12	4,533	Feb. 13	3,940
Feb. 3	4,539	Feb. 5	4,524	Feb. 6	3,960
Jan. 27	4,577	Jan. 29	4,524	Jan. 30	3,977
Jan. 20	4,588	Jan. 22	4,532	Jan. 23	3,974
Jan. 13	4,614	Jan. 15	4,539	Jan. 16	3,952
Jan. 6	4,427	Jan. 8	4,568	Jan. 9	3,953
1944		1943		1942	
Dec. 30	4,226	Jan. 1	4,337*	Jan. 2	3,780†
Dec. 23	4,617	Dec. 25	4,296	Dec. 26	3,656
Dec. 16	4,563	Dec. 18	4,613	Dec. 19	3,976
Dec. 9	4,538	Dec. 11	4,567	Dec. 12	3,938
Dec. 2	4,524	Dec. 4	4,560	Dec. 5	3,884
Nov. 25	4,369	Nov. 27	4,403	Nov. 28	3,766

* 1944 † 1943

Percent Change from Previous Year

	Week Ending		
	Feb. 10	Feb. 3	Jan. 27
New England	— 1.9	+ 2.3	+ 1.8
Mid Atlantic	— 3.7	— 2.0	— 0.2
Central Industrial	+ 1.6	+ 2.2	+ 4.1
West Central	+ 9.2	+ 8.4	+ 9.8
Southern States	+ 4.9	+ 5.6	+ 6.4
Rocky Mountain	—11.5	—10.8	—12.6
Pacific Coast	— 4.5	— 2.5	— 5.4
Total United States	— .06	+ 0.3	+ 1.2

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission, in a series of orders recently issued affecting electric utility companies:

HAS APPROVED the proposed sale by Niagara Hudson Power Corp. to New York Power & Light Corp. of all the 67,000 outstanding shares of common stock, without par value of Hudson Valley Fuel Corp., and the merger of the latter into New York Power, subject to final approval of the merger by the Public Service Commission of New York. In consideration, New York Power will issue and transfer to Niagara Hudson 192,015 shares of its no par common stock, having a stated value of $6,700,000. Both New York Power and Hudson Valley are subsidiaries of Niagara Hudson. After consummation of the proposed transactions, Niagara Hudson's investment in the common stock of New York Power will consist of 1,250,000 shares, which will have a carrying value of $22,093,911.

DENIED MOTIONS filed by three groups of stockholders of New England Public Service Co., requesting an SEC order making it necessary for New England Public Service to dispose of certain of its textile subsidiaries before it simplifies its corporate structure as directed by the SEC. A plan filed by the company on Oct. 25, 1944, would distribute the stocks of New England Industries, Inc., and three utility subsidiaries to stockholders. After this step, New England Public Service would be merged into Industries, which holds seven industrial subsidiaries, most of which are textile mills in Maine. Shortly after denying the request, the SEC opened hearings on the plan and immediately five groups of stockholders requested permission to be heard. All the groups which filed motions were represented at the hearing. Harlow Lester, counsel for the SEC, said the commission's denial of the motions was made "without prejudice" and pointed out that the objecting groups "will have ample opportunity to file alternate plans or suggestions for alternate plans. . . ."

HAS GRANTED North Continent Utilities Corp. an additional six months in which to liquidate and dissolve in accordance with the commission's order of November 16, 1943. The extension of time dates from November 16, 1944.

EXTENDED UNTIL April 6, 1945 the time in which to consummate certain transactions to complete the liquidation and dissolution of the La Porte Gas & Electric Co. La Porte, a subsidiary of United Light & Power Co., will sell its electric, gas and heat properties to Northern Indiana Public Service Co., and La Porte Heat Corp., a subsidiary of Northern. Northern Indiana is a subsidiary of Midland Utilities Co. The commission approved the proposed transactions on December 7, 1943. Request for an extension was made by United.

HAS GRANTED request of United Corp. to be made a party to the proceedings dealing with the application of Columbia Gas & Electric Corp. for approval of a plan involving, among other things, a reclassification of its outstanding preferred, preference and common stocks into a single class of capital stock and the distribution of the latter. Columbia plans to distribute the new stock, along with stocks of two subsidiaries, Cincinnati Gas & Electric Co. and Dayton Power & Light Co., to its own stockholders.

HAS APPROVED International Utilities Corp.'s plan to redeem 30,000 shares of its $3.50 preferred stock, $50 par value, at $52.50 a share plus dividends. The shares are to be chosen by lot from among the 92,812.2 outstanding.

Applications Filed

Northern States Power Co. (Wis.) has applied for commission approval of its acquisition of the steam heating business of Willow River Power Co. In August, 1944, Northern States proposed to acquire all the property of the Willow River Power Co., excepting cash on hand and a claim against the United States Government now in litigation, for a total of $840,000, subject to adjustments. Wisconsin Public Service Commission and the Federal Power Commission have authorized the transaction.

North American Co. requested commission authority to pay a dividend on its common stock in shares of common stock of Pacific Gas & Electric Co. at the rate of one share of the latter for each 100 shares of North American's outstanding common. The dividend would be payable on April 2 to stockholders of record on March 2, 1945. Cash will be paid in lieu of fractional shares.

Hearings Scheduled

MARCH 6: Reconvened hearing with respect to American Gas & Electric Co. and its subsidiaries. In setting hearing the commission announced its tentative conclusions regarding an application filed by American Gas & Electric Co. under Section 11 (B) of the Public Utility Holding Company Act of 1935. The Commission declared that the properties of the following fourteen companies composing the "central system" of American may be retained under common control under the standards of Section 11 (B) (1) of the act: Appalachian Electric Power Co., West Virginia Power Co., Indiana and Michigan Electric Co., Kanawha Valley Power Co., Kentucky and West Virginia Power Co., Inc.; Kingsport Utilities, Inc., Ohio Power Co. (except for water-service properties); Beech Bottom Power Co., Inc.; Windsor Power House Coal Co., Windsor Coal Co., Southern Ohio Public Service Co., Twin Branch Railroad Co., Wheeling Electric Co. and American Gas & Electric Service Corp. (to the extent of performing services for the above-named companies). The commission also stated that if the above-named properties are retained, the company must divest itself of all interests, direct or indirect, in the following nine companies in order to conform with Section 11 (B) (1) of the act: Atlantic City Electric Co., Deepwater Operating Co., South Pennsgrove Realty Co., Scranton Electric Co., West Pittston-Exeter Railroad Co., Radford Limestone Co., Inc., Franklin Real Estate Co., Indiana Franklin Real Estate Co. and the Duncan Falls Co.

MARCH 14: On plan filed by Louisville Gas & Electric Co. of Delaware, a subsidiary of Standard Gas & Electric Co. for its liquidation. The company's sole assets are 883,161 shares of the common stock of its major subsidiary, Louisville Gas & Electric Co. of Kentucky, and net current assets of approximately $987,000 as of Sept. 30, 1944.

UTILITY REPORTS

	Net Income 1944	1943
*Detroit Edison and subs....	$6,539,624	$8,796,893
*Gulf Power	453,590	395,269
*Louisville Gas & Electric...	2,772,631	2,893,681
*Pacific Lighting	†6,331,037	6,171,505
*Pacific Power & Light.....	†516,881	1,227,856
*South Carolina Power.....	491,564	601,793

*Twelve months ended December 31.
†Preliminary.

Southwestern Utility Offers Refunding Issue of Bonds

The first electric utility system to complete the simplification prescribed by the Public Utility Holding Company Act is refunding its bonded debt and preferred stock. The Southwestern Public Service Co., until December 5, 1944, was a unit in a disconnected system with 17 companies controlling properties scattered over eight states; it is now an operating company serving principally one related area in the Panhandle section of Texas and Oklahoma.

New financing consists of the offering by an investment banking group headed by Dillon, Read & Co. of $17,500,000 first mortgage 3⅛ percent bonds, dated November 1, 1944 and due November 1, 1974, at 103¾; and 50,000 shares of 4¾ percent, cumulative, $100 par value preferred stock at $110.50 a share.

Southwestern is simultaneously affording to the holders of its 6½ percent cumulative, $100 par value preferred stock, the opportunity to exchange for the new preferred stock on a share-for-share basis, plus a cash settlement.

Net proceeds from the sale of the securities, together with general treasury funds and special funds of $4,875,763 received by the company from the sale of securities of Gulf Public Service Co. and certain small properties, will be used to redeem $20,000,000 first mortgage and collateral trust 4 percent bonds due 1972 and the unexchanged remainder of 6 ½ percent preferred stock.

Appointed in Tennessee

Before leaving office on January 16, Governor Prentice Cooper of Tennessee replaced the entire Tennessee Rural Electrification Authority with these new members to serve three-year terms, E. O. McLean, Denton Fly, and Culan V. Biddle.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Welded Drum Rack for Safety, Economy*

A combination drum rack and lifting device has been developed to enable two men to rack up with comparative ease steel drums containing material such as transformer oil, weed killer and lubricating oil. The combination, termed a rack, was devised by the author since manpower is sometimes limited at substations at the time a drum is to be placed on the rack. It eliminates use of a long plank on which to roll the drum up into place and for which space may not be available; also use of chain or rope falls which would require a suitable place to fasten overhead.

With the combination one man can

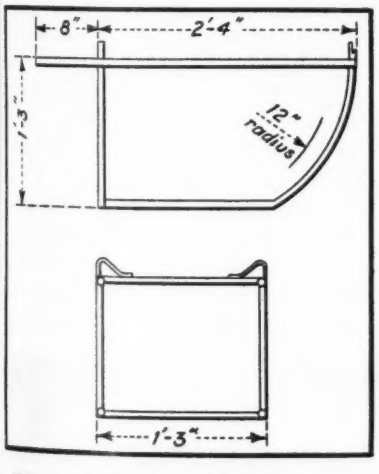


FIG. 1—Outline of welded drum rack

put a drum on the rack by tying a short rope sling around the top of the drum and rack, inserting the handles, placing one foot against the cross bar and pulling the rack and drum back toward himself, thus lifting the drum off the floor and at the same time laying it down on the rack. This operation can be carried out by one man provided the drum is placed on end. If it is lying on its side the effort to set it on end by the use of more than one man is far less than loading the drum by the old method.

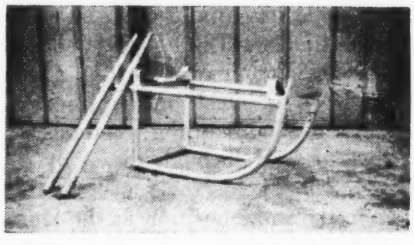


FIG. 2—Drum rack and handles fabricated by arc welding

The material used in the construction of the rack (Fig. 1) consists of 20 ft. of 1-in. black iron pipe at a cost of $1.86, one piece of 2½ by 2½-in. by 18-in. long angle iron, four pieces of flat iron ¼ in. by 1¼ in. Estimated cost of angle and bar iron, 40 cents. One pound of 5/32-in. welding rod was used at a cost of 10 cents per lb. making the total cost of material $2.36.

Four hours time was consumed building the first unit, at 90 cents per hour. The cost of labor was $3.60, added to the cost of material ($2.36), making the total cost of the first rack $5.96. This time could be reduced to one hour or possibly less if large quantities were to be built.

One pair of handles can be used for any number of racks used on the same job. In our case three racks were built. The handles consist of two pieces of 1-in. pipe 30 in. long with a 12-in. piece of hot rolled steel inserted part way into the end of the pipe and welded. Additional cost of material was estimated at 40 cents.

Enough pipe was salvaged for the construction of the three racks, the only additional material purchased being the two pieces of hot rolled steel. Labor was figured in on the construction of the first rack. The 1-in. pipe can be bent with a single roller or by hand with a pipe bending tool, and a hacksaw is the only other tool that is needed.

Possibly the greatest advantage of this type of drum rack, a close-up of which is shown in Fig. 2, is the increased safety in handling drums. It practically eliminates all lifting strains, permitting the man to do his work in an upright position, and avoids possible drum slipping.

* From a paper submitted by R. D. Loescher, maintenance foreman, The Ohio Power Co., Canton, Ohio, in the Industrial Progress Award Program sponsored by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

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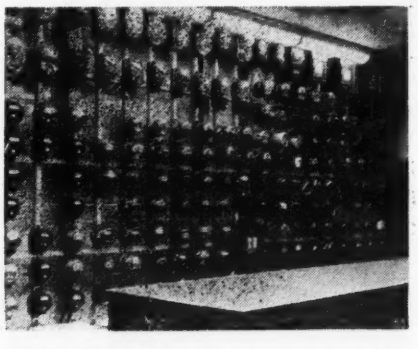
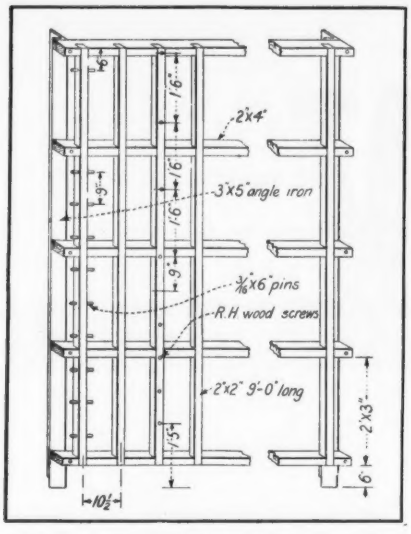
Rack Holds All Types of Meters

By C. W. PINKEL
Illinois Power Co., Belleville, Illinois

A meter rack has been devised to hold all types of electric meters including single-phase, three-phase,



THE LARGER meters are hung on the two top rows because they are less frequently handled



RACK is supported by 2 by 5-in. angle irons. And the 2 by 2 in. timbers (each 9 ft. long) are spaced to allow adequate room for all types of meters. The R. H. wood screws project ½ in.

two, three and four-wire indoor and outdoor meters and indicating and strip chart type demand meters. The part of the rack nearest to the outgoing door is kept for the meters that have been repaired and shop tested and are ready to go back into service. The remaining part of the rack is used for the storage of meters which need a regular repair and shop test. This type rack makes all meters available for regular monthly inventory.

The rack is built next to one wall at the meter shop so as to use as little space as possible. The wood screws used to support the meters are spaced to allow meters to be hung one above the other without touching and yet without wasting space.

At one end of the rack, provision is made to hold the early type of socket meter that had no hanger on the back of the socket. Holes are drilled horizontally through the 2 by 2-in. supporting timbers. The old style socket meter is held up against the 2 by 2 and a 3/16 by 6-in. steel pin is inserted through the holes in the terminals of the socket and through the 2 by 2. This method holds the socket to the rack in the same position as the later type meters.

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Manhole Bus Relieves Congested Condition

By GEORGE K. TASHJIAN

Engineer, Underground Department, Cincinnati Gas & Electric Co., Cincinnati, Ohio

To combat congestion in manholes of the Cincinnati underground system, particularly at street intersections where several service cables originate and large numbers of low-voltage a.c. network mains are interconnected, resort has been had to a common manhole bus to which all low-voltage network main and service cables in the manhole are connected.

Use of such a bus construction in manholes has several advantages. It eliminates congestion in manholes and multiple splices on mains, gives greater flexibility to install and remove secondary mains and services and eliminates some of the hazards to workmen—an important factor. Moreover, fire hazards are reduced since a greater capacity is available to clear a fault. And, furthermore, the bus affords a foundation for future improvement of the system should limiters or other similar equipment be installed.

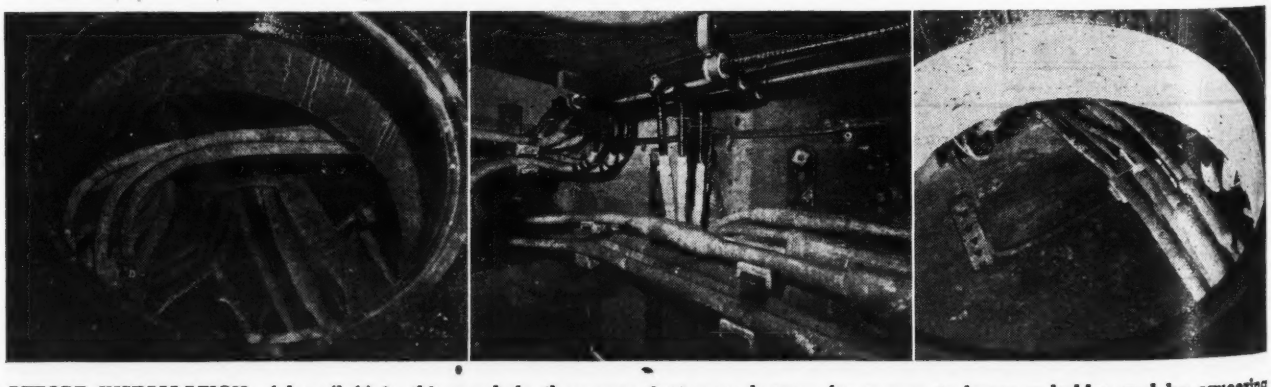
Congestion leading to evolution of the manhole bus was the result of a combination of several factors. There has been a great increase in the maximum demand of the low-voltage a.c. network load. Part had been due to a.c. to d.c. changeover. As new a.c. customers were added taps were taken from secondary street mains, wherever possible. Contributing also to congestion was the fact that in most distribution manholes, d.c. mains and feeders of the old Edison system passed through the same duct system as the a.c. mains. Tapping of d.c. mains for d.c. service and a.c. mains for a.c. services really clogged quite a number of manholes. In some cases it was a real hardship for workmen to get in and out of the manholes.

To relieve some of the conditions illustrated, a complete inspection was ordered to locate and recommend improvements on all congested manholes. Resort to the manhole bus was the result of this investigation.

Precedent for the manhole bus lay in earlier favorable experience with another form of secondary bus used at all transformer vaults on the low-voltage a.c. network system, except in the flood area. In such vaults the secondary leads from the transformer (after passing through the protector), the main from the street and the services to the immediate customer are connected to this secondary bus.

Secondary mains on the Cincinnati network consist of 400,000-cir. mil single-conductor paper-insulated lead-covered 0.6-kv. cable.

Accompanying illustrations show a common form of manhole bus that has been installed. Form of the bus varies with the particular situations at hand. Some buses are circular,



BEFORE INSTALLATION of bus (left) in this manhole there was just enough room for a man to lower a ladder and by squeezing reach the manhole floor. Inside the manhole (center) after installing the a.c. bus and rearranging the cables. Bus has been taped but not fire-proofed when picture was taken. Greatly reduced congestion (right) marks rearranged manhole

others "U" or "L" shaped while still others are straight. In all cases the bus conductors are fastened to the manhole ceiling by insulated bus clamps as shown.

Bus conductors of 1,000,000-cir. mil area, was obtained from an excess supply of spare Edison cable that had been removed from the system and from which lead sheath and insulation had been stripped. The ground bus, to which main and service cable sheaths are bonded, is fastened to the manhole wall uninsulated. The phase conductors of the bus, on the other hand, are taped and fire-proofed after connections are completed.

Cost of the manhole bus is considered to be secondary to:

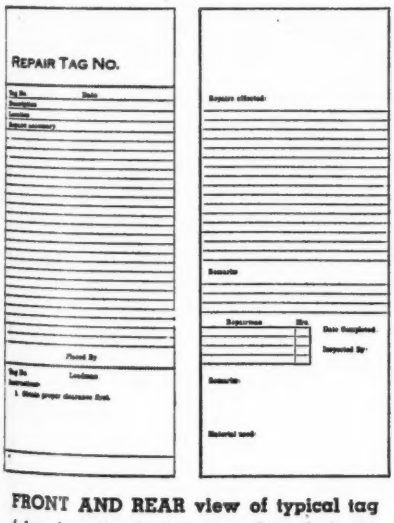
1. The improvement in manhole arrangement.
2. Accessibility for installing and removing mains and services.
3. Flexibility. If trouble occurs on any branch it can easily be cut loose.

Moreover, the ability of the bus to dissipate easily the excess heat due to high current density in the mains, is very desirable.

Adaptability of the bus scheme to possible future network improvements is also notable. Preceding the war emergency, for example, of limiters on all the a.c. secondary mains. War restrictions of the last three years caused the postponement of this plan. However, the fact that all connections to the manhole bus are made with solderless connectors of the body and lug type, will facilitate the installation of limiters on the end of these mains permitting the bus structure to be utilized effectively and economically.

Handy Repair Card Simplifies Maintenance

A simple repair card that covers all functions from discovery of defect to restoration of equipment has been devised by Charles Kiel, superintendent of generating plant, Queens Borough Gas & Electric Co., Far Rockaway, L. I., N. Y. and his associates. The card started by a watch engineer, repairman, or any other responsible employee who tags the equipment needing attention, keeps a record of the work to be done, who did it and the time consumed in repairs as well as listing the parts or materials used.



FRONT AND REAR view of typical tag (size 4 in. by 10 in.) started by L. Smith showing the work to be done on No. 5 pulverizing mill

Card issued by S. Richards, chief electrician, after inspection of the mill motor and controls

A supply of the numbered tags is conveniently placed around the plant so that the men while making their daily inspections or during the normal pursuit of duty can fill one out immediately (and not rely on memory) when some abnormality is noticed.

Typical card started by L. Smith of the steam maintenance department is shown. The upper portion is torn off and conspicuously hung on the equipment (in this case No. 5 pulverizing mill in the low pressure mill room). The remainder of the card is left with the foreman who immediately contacts the chief electrician. He then makes an inspection of motor, contacts and controls and issues a similar card for the electrical maintenance crew. Both cards are identical except for numbers. Both crews working simultaneously carry out the instructions on their individual cards. When the work is completed the leadman fills in the names of the men on the job, the number of hours each worked and the materials used. The card is then returned to the foremen who tears off the bottom part and passes it to the stock clerk. In this way a running inventory of stock-on-hand is facilitated. The center section containing the information on the work that was done and the men involved is filed against the equipment. In this way a running history of the maintenance on any piece of equipment in the station is always available.

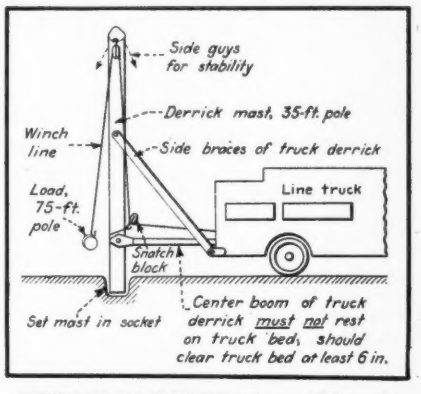
Three unlooked for results came about from the use of this system:

1. It keeps all men on the alert.
2. It increased the pride of the men in the operation of the plant equipment.
3. It stopped abruptly the perennial growls about "reporting things and nothing being done about them."

•

Improvised Derrick Handles Long Poles

Pole derricks used on line trucks have distinct limitations on the size of pole that can be handled with safety and convenience. It is possible to circumvent this limitation in an emergency through the exercise of a little ingenuity. A case in point was uncovered recently in Indiana where a utility construction supervisor built a stiff-leg derrick to handle 75-ft. poles using members of the truck derrick and a 35-ft. pole. The rigging scheme is shown.


Side guys for stability
Derrick mast, 35-ft. pole
Winch line
Side braces of truck derrick
Line truck
Load, 75-ft. pole
Snatch block
Set mast in socket
Center boom of truck derrick must not rest on truck bed, should clear truck bed at least 6 in.

DERRICK IMPROVISED from 35-ft. pole and members of conventional truck boom used in setting 75-ft. poles

The 35-ft. pole, used as the mast of the improvised derrick was set in a shallow socket and braced laterally by bolting tubular side members of the truck derrick to it. The boom or center member of the truck derrick was extended out almost horizontally *above* the bed of the truck and it also was bolted to the mast pole, in the manner shown. Snatch blocks lashed to the mast at bottom and top to guide the truck winch line complete the rigging.

Two important precautions should be observed in using a rig such as this. First, in extending the boom or

center member of the truck derrick out of the pole mast it should be kept at least 6 in. off the truck bed. It will be apparent that if the boom rests on the truck floor when a load is lifted, any slight sinking of the derrick mast under load will place a severe load on the boom. Second, it is desirable to side-guy the derrick boom to improve lateral stability of the structure.

• • •

Clearance Between Conductor and Guy

By H. A. HOLMES

Consulting Engineer, Monongahela West Penn Public Service Co., Fairmont, West Virginia

In the design of a transmission or distribution structure, it is frequently necessary to attach a guy to the pole at a point above one or more of the crossarms. If there is an angle in the line at such a structure the clearance between the guy and the conductor becomes important. This clearance can be regulated by adjusting the lead of the guy but a change in the lead affects the stress on the guy and the engineer should be able to specify the lead, number and sizes of guys to be used. If adequate clearance cannot be obtained, it may be necessary to insert wood strain insulators adjacent to the conductor.

The computation can be reduced to a relatively simple form. The illustrations represent conditions for guy attachment. While the illustrations show a single pole, it may be one of several and there may be no crossarm.

Nomenclature used:

D = Minimum distance between conductor and guy
α = Angle in the line at the structure
b = Height of guy attachment above conductor plane
d = Horizontal distance from vertical plane through the guy to the point of conductor attachment
H = Vertical distance from the point of guy attachment to the point where it enters ground
L = Horizontal distance from the point of guy attachment to the point where the guy enters ground
B = Vertical distance from the guy up to the conductor in the plane of the guy. (Use negative sign when guy is above conductor)
l = Horizontal distance in plane of guy from center line of crossarm (or arms) to line of intersection with conductor plane.

B must be positive or negative or the guy and conductor will intersect. The clearance will be less than B and values of H/L, d and b must be chosen to give a value of B somewhat in excess of the clearance desired. If d and b are fixed by the structure, then H/L must be such as to give the necessary clearance.

Three positions of the crossarm (or of the center line between poles if no arm is used) are probable and values of B for each position are as follows:

Crossarm bisects line angle:

$$B = \frac{Hd}{2L \sin \frac{1}{2}\alpha} - b$$

Crossarm at right angles to span being guyed:

$$B = \frac{H\,d}{L \tan \alpha} - b$$

Crossarm at right angles to span in which guy is located (this gives the greatest clearance):

$$B = \frac{H\,d}{L \sin \alpha} - b$$

The following values apply to all three cases:

$$X = \frac{H\,B}{L\left(4 \sin^2 \frac{1}{2}\alpha + \frac{H^2}{L^2}\right)}$$

$$F = 2x \sin \tfrac{1}{2}\alpha$$

$$G = B - \frac{H\,x}{L}$$

$$D = \sqrt{F^2 + G^2}$$

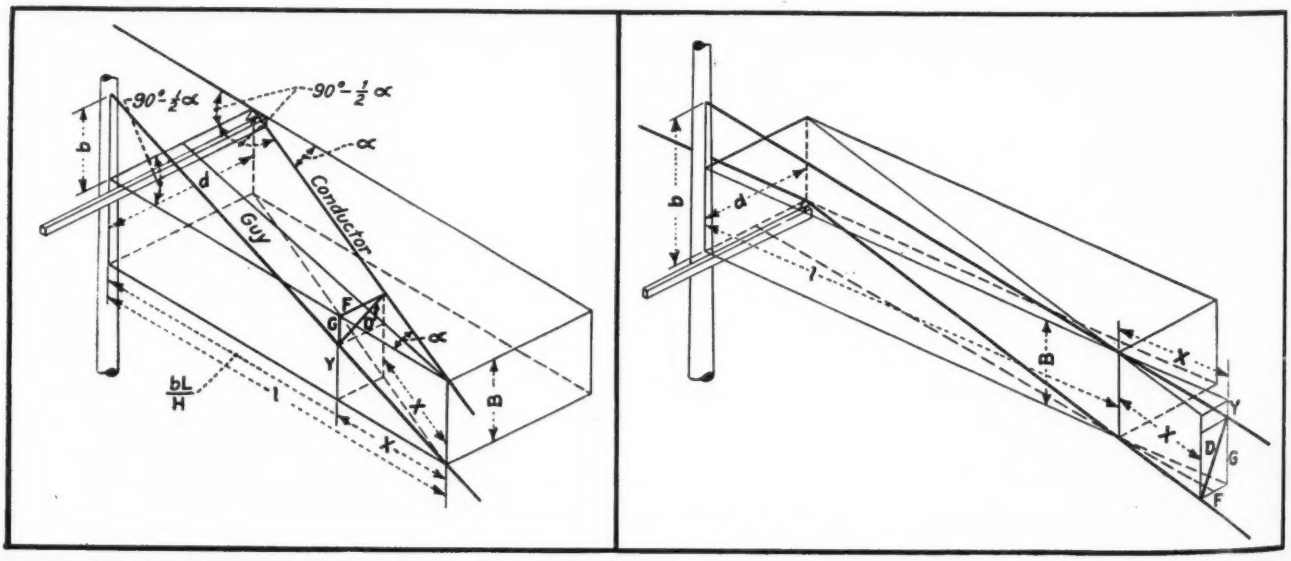
•

Results of Tests Made on a 6,000 HP. Diesel

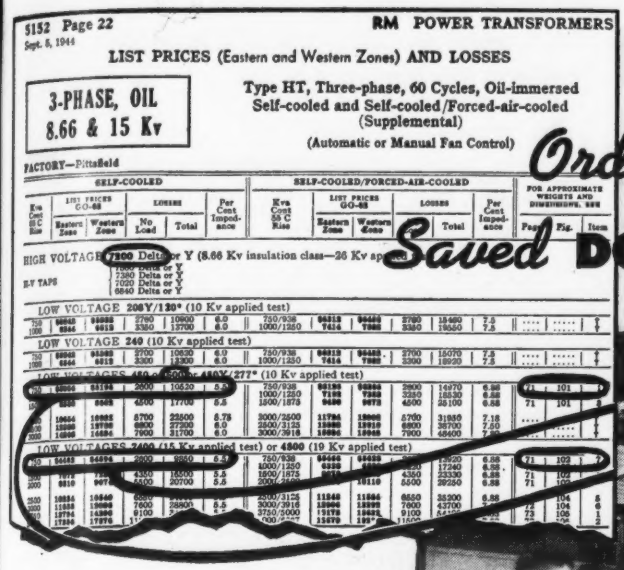
Tests completed on an unusually large two-cycle, single-acting, crosshead type diesel engine show that it will develop 6,000 shaft hp. continuously at a speed of 160 rpm. and a brake mean effective pressure of 62 psi. This engine with nine cylinders, 29-in. cylinder bore and 40-in. stroke was built by the Nordberg Manufacturing Co., Milwaukee, Wis., is intended for direct drive marine service and is to be installed in a "Victory" ship of the United States Maritime Commission.

For stationary service this type of engine would have a speed of 164 rpm. at which the standard rating per cylinder is 500 kw. Thus the foregoing nine-cylinder engine develops 4,500 kw.

Fuel injection system used is the mechanical type with water-cooled



ATTACHMENT OF GUY TO POLE. (Left) Conductor is above guy; crossarm bisects line angle. (Right) Guy is above conductor



5152 Page 22 — RM POWER TRANSFORMERS
Sept. 8, 1944

LIST PRICES (Eastern and Western Zones) AND LOSSES

3-PHASE, OIL
8.66 & 15 Kv

Type HT, Three-phase, 60 Cycles, Oil-immersed
Self-cooled and Self-cooled/Forced-air-cooled
(Supplemental)
(Automatic or Manual Fan Control)

FACTORY—Pittsfield

SELF-COOLED | SELF-COOLED/FORCED-AIR-COOLED | FOR APPROXIMATE WEIGHTS AND DIMENSIONS, SEE

HIGH VOLTAGE 7200 Delta or Y (8.66 Kv insulation class—26 Kv applied test)
7360 Delta or Y
7620 Delta or Y
8640 Delta or Y
H.V. TAPS

LOW VOLTAGE 208Y/120* (10 Kv applied test)

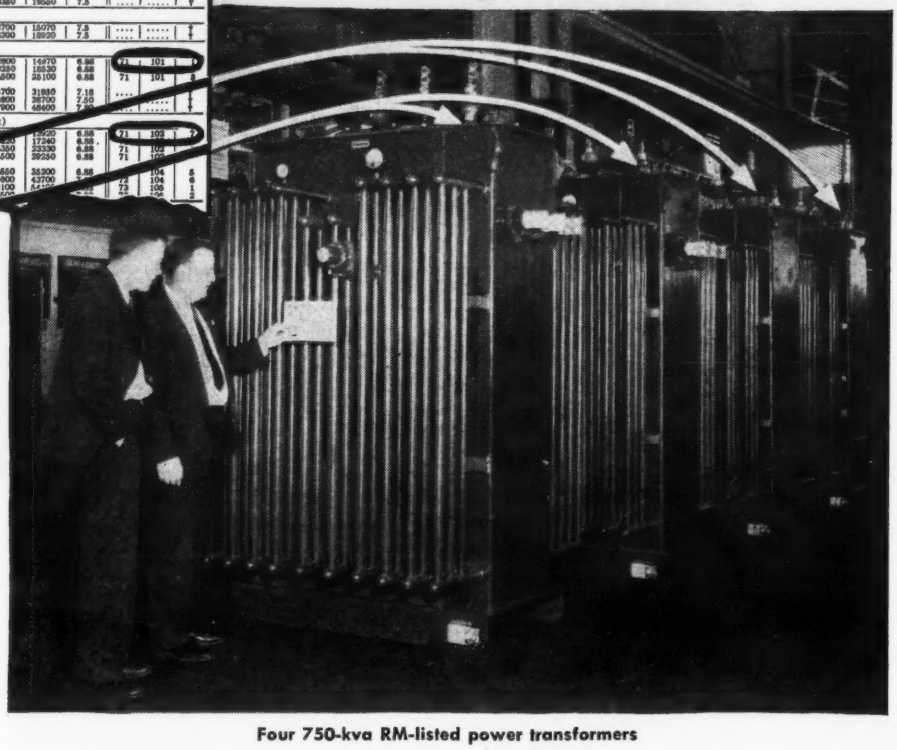
LOW VOLTAGE 240 (10 Kv applied test)

LOW VOLTAGES 480 or 480Y/277* (10 Kv applied test)

LOW VOLTAGES 2400 (15 Kv applied test) or 4800 (19 Kv applied test)

Ordered "AS LISTED" *Saved* DOLLARS and MAN-HOURS

THESE TRANSFORMERS, PURCHASED "RIGHT OUT OF THE HANDBOOK," SHOW THAT G.E.'S KIND OF STANDARDIZATION IS ENTIRELY PRACTICAL



Four 750-kva RM-listed power transformers

The mutual benefits gained from *continually improved* standard designs are no longer a matter of abstract argument. The list of standard G-E transformer ratings was compiled after detailed study of industry requirements, and purchases are being made with increasing frequency directly from that listing.

Repetitive manufacture of these listed types saves time and materials in manufacture, helps us to deliver *more transformer value* per dollar, and with less likelihood of delay. In the long run, repetitive manufacture means lower apparatus prices, and lower investment costs for you.

In the future, we expect to expand the range of power apparatus available in "RM-listed" types and sizes. You'll find that it pays to make "Repetitive Manufacture" your choice whenever possible. *General Electric Company, Schenectady 5, New York.*

RM-listed power transformers are now available for circuits 66,000 volts and below; 667 to 5000 kva, single-phase; 750 to 10,000 kva, three-phase.

THE BUILDER APPLIES
More fundamental design time per model
More production efficiency per hour

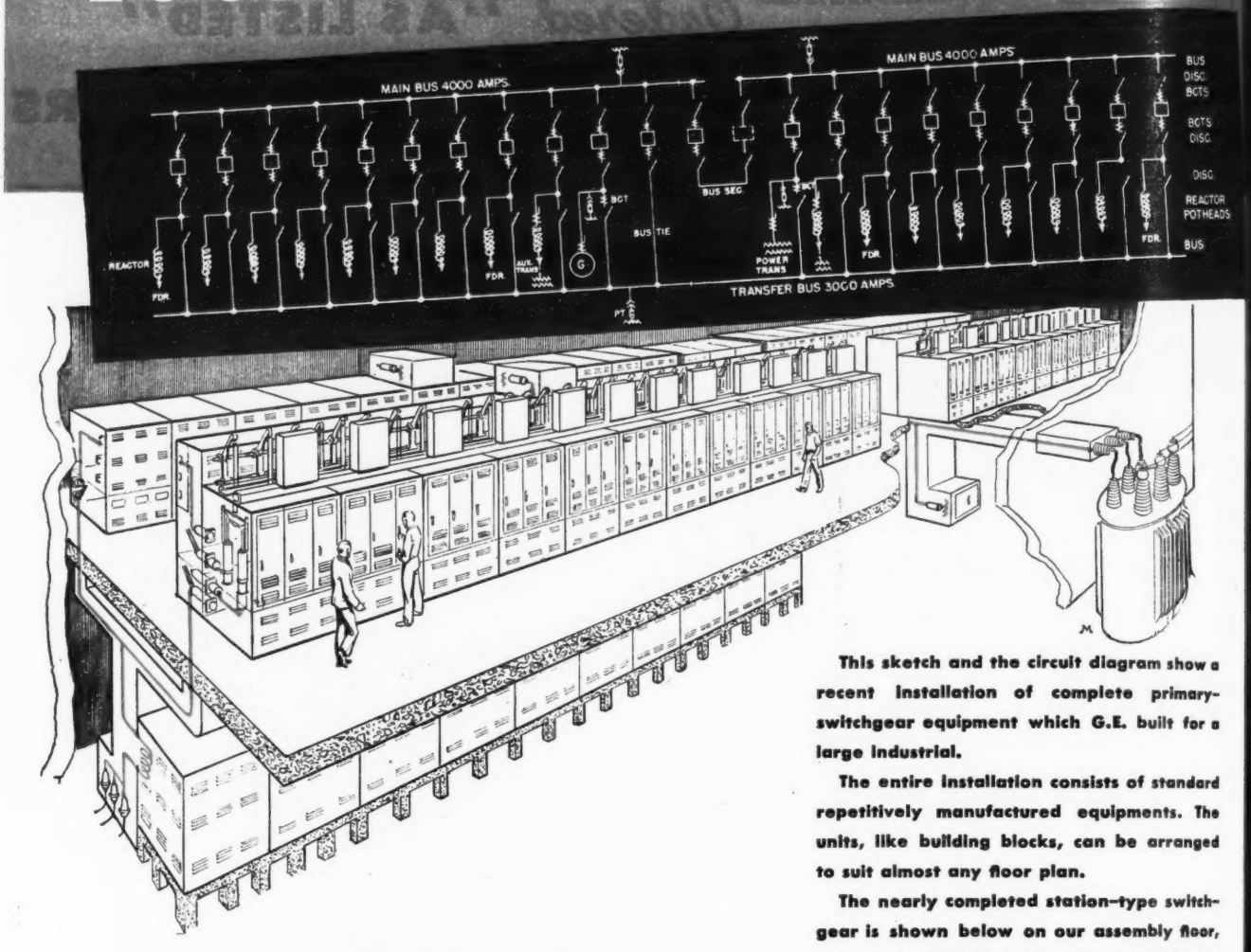
A New Field for Co-operation
Repetitive Manufacture

THE BUYER GAINS
More kva capacity per dollar invested
Less maintenance cost per year

Buy all the BONDS you can — and keep all you buy

GENERAL ELECTRIC

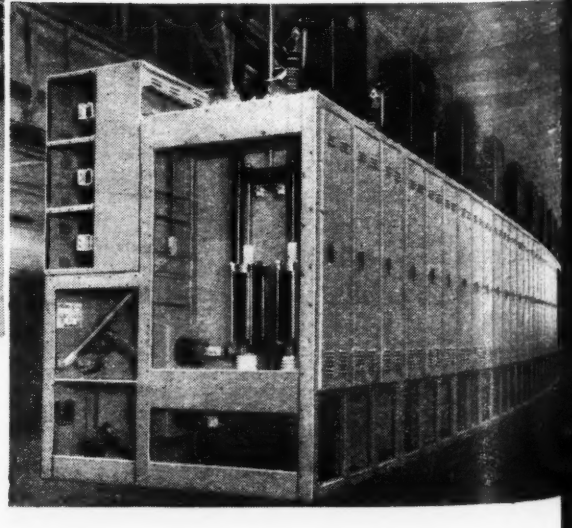
LOOK FORWARD TO THIS



This sketch and the circuit diagram show a recent installation of complete primary-switchgear equipment which G.E. built for a large industrial.

The entire installation consists of standard repetitively manufactured equipments. The units, like building blocks, can be arranged to suit almost any floor plan.

The nearly completed station-type switchgear is shown below on our assembly floor, where we duplicate the actual installation floor plan and test all such assemblies to insure proper co-ordination. The complete equipment is designed with accent on accessibility of all parts for easy maintenance, and must be right both electrically and mechanically before it is shipped.



Metal-enclosed, transfer-bus compartments (left) and FH cubicles (right) in final stages of construction. These equipments contain everything necessary for proper operation—require only metal-enclosed bus-run connections to related equipments and secondary connections to the metering-and-control center.

BUY WAR BONDS

TYPE OF SWITCHGEAR

It enables you to apply your most advanced thinking and do it at the lowest investment cost—

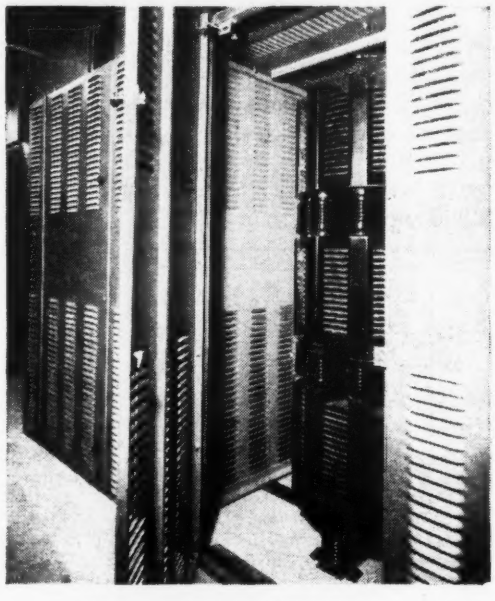
...for a station or even a whole system

THIS metal-enclosed primary switchgear, for circuits up to 33 kv, and with interrupting ratings up to 2,500,000 kva, is so designed that it can be factory-assembled in many standard combinations.

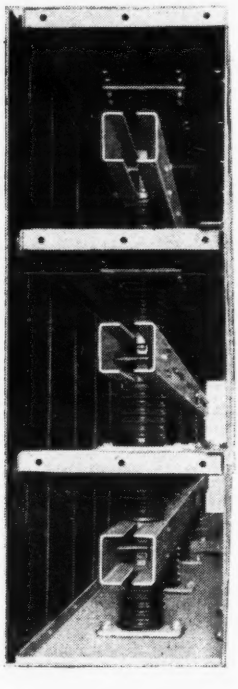
Its versatility enables you to meet almost any circuit arrangement and functional requirement with standard, repetitively manufactured equipment.

The same versatility permits you to make the best possible use of your available floor space. The basic units of equipment can be assembled in such a way, and the equipments so grouped and located, that, usually, major reconstruction or an addition to the building is not necessary. On new construction many purchasers, stimulated by the variety of factory-assembled combinations available, have made important savings by designing the building to fit an ideal arrangement of equipments.

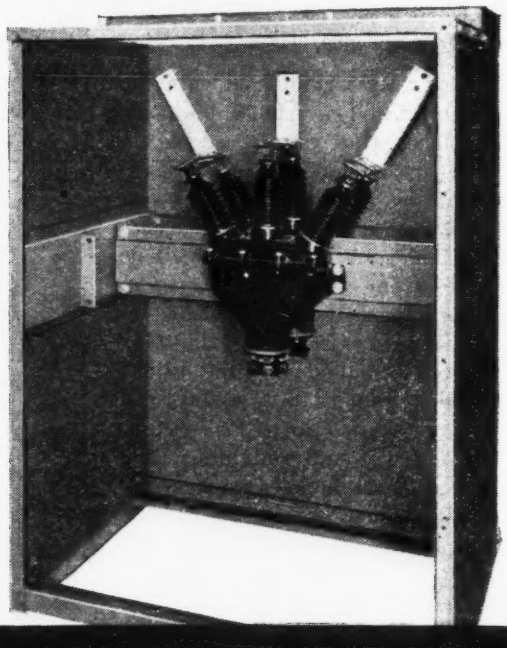
Complete, standard G-E switchgear equipments are available for the high-voltage primary circuits and the low-voltage auxiliary circuits. Whether you are planning new construction or want to modernize an installation, ask your G-E representative how standard switchgear equipments can help you to provide better circuit protection, regulation, relaying, or control. *General Electric Company, Schenectady 5, New York.*



Metal-enclosed feeder-reactor compartments



Metal-enclosed, three-phase bus runs



Metal-enclosed cable-entrance compartment with three-phase pothead

PACKAGED SWITCHGEAR

GENERAL ELECTRIC

855-17-7300

fuel nozzles and includes fuel pumps. The engine is also designed for the application of the Nordberg system of gas injection.

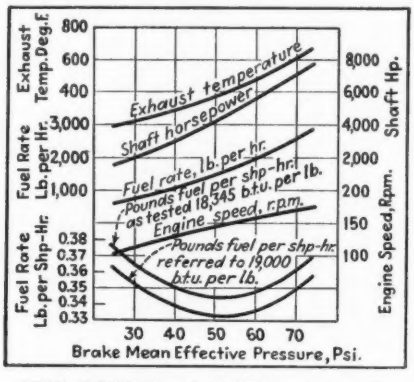
Scavenging air is furnished by two motor-driven centrifugal blowers, each separately connected to the scavenging header which is located near the top and on one side of the engine. Exhaust header is on the opposite side of the engine.

The 17-day continuous test of the engine erected in the company's shop included the following tests:

(a) 360 hr. continuous endurance run with the engine developing normal shp. of 6,000 at 160 rpm.

(b) 48 hr. continuous run at 110 percent load or 6,450 shp. at 165 rpm.

(c) 2 hr. run at 125 percent load or 7,300 shp. at 172 rpm.



TEST RESULTS of 6,000-hp. two-cycle, single-acting Nordberg marine diesel engine; data does not include power to drive scavenging blower.

All tests were conducted with the engine burning heavy fuel oil and the fuel consumption results are shown on the accompanying chart. Fuel consumption as shown does not include the power to drive the scavenging air blower. This power will be obtained from the auxiliary generating sets aboard the vessel. Input to the blower at normal load is 430 bhp.

Fuel consumed during the 17-day test varied from 1,000 to 1,200 SSU. at 100 deg. F., 11.25 to 12.5 Baume at 60 deg. F., and containing from 11.4 to 17 percent hard asphalt and 9 to 10 percent Conradson residue.

Samples of fuel oils used during the official test showed the following average analysis after being centrifuged:

SSU at 100 deg. F.	1,076
Baume at 60 deg. F.	11.5
Flash point deg. F.	261
Fire point, deg. F.	324
Sulphur	0.82
Water and sediment, percent	0.59
Asphalt, hard, percent	13.2
Conradson residue, percent	9.57
B.t.u./lb., HHV	18,345

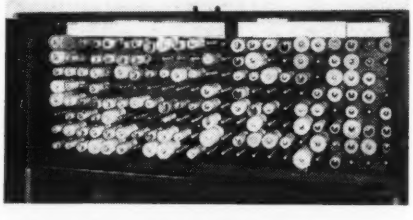
Prior to the beginning of official tests, heavier fuel oils of 1,400 to 1,600 SSU. at 100 deg. F. were consumed over long periods of time with clear exhaust and with no difficulty. No changes were made in the fuel injection equipment and there was no noticeable change in fuel consumption.

•

Oscillograms Filed in Compact Cabinet

By GEORGE STEEB
Relay Engineer
Buffalo Niagara Electric Corp., Buffalo, N. Y.

All the films taken on automatic oscillographs of various system disturbances are kept in a single cabinet which provides 192 pegs on which they can be placed in rolled-up form. Pegs are dowel rod of lengths equal to the width of standard film and are spaced about 2 in. apart. Successive records for any one line are pasted together to make a continuous roll. Some lines have provided so many automatic records that more than one peg is required for filing them.



ROLLED OSCILLOGRAMS of system tests and disturbances kept in convenient compact form for ready reference

All the oscillograms are dated and identified and then placed on the proper peg in a vertical column which is labeled at the top with line identification data.

The cabinet has doors which do not show in the accompanying photograph.

•

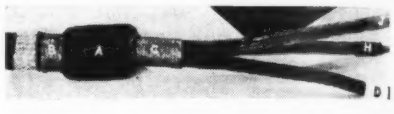
Cable End Sealing Defeats Moisture

Method of sealing the open ends of cables carrying current vital to the operation of fighting ships and their armaments has been devised by joint action between the Navy electrical design engineer and Owens-Corning Fiberglas Corp. The method is equally applicable to cable laid in moist spots in the utility field.

Vulnerable Paint

The vulnerable point of the cable is at the point where the cable armor has been removed to permit separation of the conductors for hook-up. This open end is usually enclosed in a moisture-tight terminal box, but if the box is damaged there is the possibility that water entering the open cable end will work into the cable, causing a short.

Materials required for sealing the cable, independent of the terminal box, are a non-moisture-absorbent wax with a fairly constant viscosity range, Fiberglas tape impregnated with a synthetic rubber compound, and treated Fiberglas tying cord. The tape and tying cord are employed



CROTCH IS FILLED with a moisture-proof insulating compound. Over this a Fiberglas tape is wrapped (shown at A). Cord is then served on at B and C working toward center of tape. Compound under stretch-proof tape is forced into crotch of cable and out toward the ends of the conductors. Insulating sheaths are tied down with different colored cord (to ease identification) as indicated at D, H and J

primarily because of their high tensile strength and because they will not stretch or absorb moisture.

Sealing Process

Since the glass tape and cord are also non-inflammable, this modification of the end of the cable does not destroy its flame resistant characteristics. The first step in the sealing process is to skin back the cable armor a short additional distance from the end, further exposing the interior conductors. The filling wax is then built up around the conductors, at the crotch. The conductors are pulled together and tightly wrapped as a unit, with strips of the tape four to six inches wide. The cord is served on from both ends toward the middle of the wax section. Thus, pressure forces the wax back into the core of the cable, forming a solid vapor-and-moisture-proof seal.

As up-to-date as the product they help manufacture—two G-E 150-kva dry-type transformers at a newly equipped factory

6 UNIQUE FEATURES

set new standards for dry-type designs— in safety, ease of installation, appearance

1 A case designed for utility, that is attractive in appearance.

2 Completely metal-enclosed construction that prevents rods and wires from being accidentally pushed into live parts of the transformer.

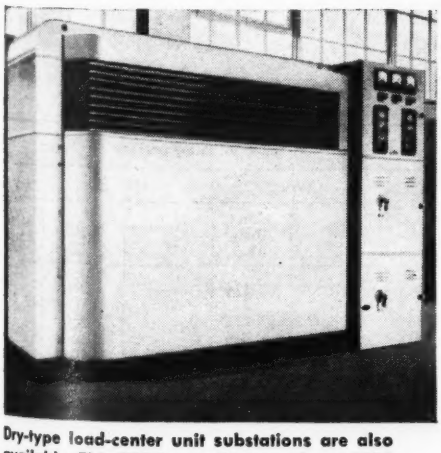
3 No exposed live parts, such as bushings, that would neccesitate enclosing the unit with a fence to protect personnel.

4 Cable terminal compartments completely removable, so that the high-voltage and low-voltage cables can be made up and the unit then slid into place between them without the use of a crane or elaborate hoisting and jacking facilities.

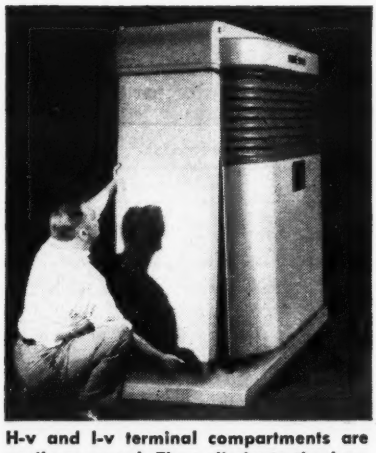
5 Readily removable casing to facilitate inspection and cleaning of the core and coils.

6 Transformers equally suitable for top or bottom connection. Can be equipped with a high-voltage pothead, if desired. Low-voltage terminal facilities are suitable for either cable or bus-duct connections.

These ultramodern distribution transformers are designed to meet AIEE Standards No. 1 for Class B insulation, with 130 C maximum hot-spot temperature in a maximum ambient of 40 C, resulting in an average temperature rise of approximately 65 C. They are now available for use on 601- to 15,000-volt primary circuits, in ratings from 100 to 2000 kva. For further details ask for Bulletin GEA-3714B. General Electric Company, Schenectady 5, N. Y.



Dry-type load-center unit substations are also available. This 750-kva unit steps down 2400 volts to 480 volts at a Southern metals plant.



H-v and l-v terminal compartments are easily removed. They eliminate the hazards of exposed bushings and wiring.

Transforms 2400 volts to 575 volts for machine tools and other factory loads at a New England plant.

GENERAL ELECTRIC

BUY WAR BONDS

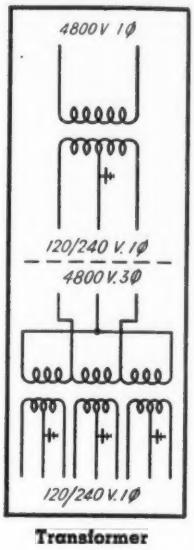
402-67-5100

TRANSFORMER DATA FOR LIGHTING AND POWER

By M. V. EARDLEY, Engineer, Power System, Dept. of Water and Power,

City of Los Angeles, California

Tables provide design data for cable, conduit and bus sizes, O.C.B. trip settings, and meter capacities, all based on transformer ratings and lighting and power loads. These tables are adapted from station construction electrical standards developed by the Power System, Department of Water and Power, City of Los Angeles.



Transformer connections for Table 1

Table 1—Transformer Data for Lighting Loads

4,800-V., 1 ph. Primary					4,800-V., 3 ph. Primary					120/240-V., 1 ph. Secondary				
Kva. per Trans.	Amp.,	Cable Size (a)	Conduit, in.	O. C. B. Trip. Amp.	Kva. per Transf.	Amp.	Cable Size (a)	Conduit, in.	O. C. B. Trip. Amp.	Amp.	Cable Size 2-Lines (b)	Cable Size 1-Neutral (b)	Conduit. Size, in.	Meter Amp.
7½	1.6	6	2	10	7½	2.7	6	2½	10	31.2	(2) 1/0	(1) 1/0	2	25
10	2.1	6	2	10	10	3.6	6	2½	10	41.7	(2) 1/0	(1) 1/0	2	25
15	3.1	6	2	10	15	5.4	6	2½	10	62.5	(2) 1/0	(1) 1/0	2	50
25	5.2	6	2½	10	25	9.0	6	2½	18	104	(2) 4/0	(1) 1/0	3	100
37½	7.8	6	2½	15	37½	13.5	6	2½	27	156	(2) 4/0	(1) 1/0	3	200
50	10.4	6	2½	21	50	18.1	6	2½	36	208	(2) 500	(1) 4/0	3½	200
75	15.6	6	2½	31	75	27.1	6	2½	54	312	(2) 500	(1) 4/0	3½	300
100	20.8	6	2½	42	100	36.1	6	2½	72	417	(2) 1,000	(1) 500	4½	400
150	31.2	6	2½	64	150	54.2	4	2½	108	625	(4) 1,000	(2) 500	(2) 4½	600
200	41.7	4	2½	84	200	72.3	1/0	3	144	833	(4) 1,000	(2) 500	(2) 4½	800
250	52.1	4	2½	104	250	90.3	1/0	3	180	1,042	(4) 1,000	(2) 500	(2) 4½	1,000
333	69.3	1/0	3	138	333	120	2/0	3	240	1,388	(6) 1,000	(3) 500	(3) 4½	1,500
500	104	2/0	3	208	500	181	250	3½	360	2,083	.....	.....	.....	2,000

(a) Cable, 5000-volt, single-conductor, varnish cambric, double braid; size AWG or M cir. mil.
(b) Cable, 600-volt, single conductor, paper-insulated, lead sheath; size AWG or M cir. mil.

Table 2—Transformer Data for Three-Phase Power Loads

4,800-V., 3 ph. Δ Primary					240-V., 3 ph. Δ Secondary						480-V., 3 ph. Δ Secondary					
						Cable		Bus				Cable		Bus		
Kva. per Transf.	Amp.	Cable Size (a)	Conduit, in.	O. C. B. Trip Amp.	Amp.	Size (b)	Conduit, in.	Main, in.	Tap, in.	Meter Amp.	Amp.	Size (b)	Conduit, in.	Main, in.	Tap in.	Meter Amp.
15	5.4	6	2½	16	108	(3) 4/0	2½			150	54.2	(3) 4	1½			50
25	9.0	6	2½	27	181	(3) 4/0	2½			200	90.3	(3) 1/0	2			150
37½	13.5	6	2½	40	271	(3) 500	3½			300	135	(3) 4/0	2½			150
50	18.1	6	2½	54	361	(3) 1,000	4½			400	181	(3) 4/0	2½			200
75	27.1	6	2½	80	542	(3) 1,000	4½			600	271	(3) 500	3½			300
100	36.1	6	2½	108	723	(6) 1,000	(2) 4½	(1) ¼x3	(2) ⅛x2	800	361	(3) 1,000	4½			400
150	54.2	4	2½	162	1,084	(6) 1,000	(2) 4½	(1) ⅜x3	(3) ⅛x2	1,000	542	(3) 1,000	4½			600
200	72.3	1/0	3	216	1,445	(9) 1,000	(3) 4½	(2) ¼x3	(3) ⅛x2	1,500	723	(6) 1,000	(2) 4½	(1) ¼x3	(2) ⅛x2	800
250	90.3	1/0	3	270	1,806	(9) 1,000	(3) 4½	(2) ¼x3	(4) ⅛x2	2,000	903	(6) 1,000	(2) 4½	(1) ¼x3	(2) ⅛x2	1,000
333	120	2/0	3	360	2,408	.....	.....	(2) ⅜x3	(4) ⅛x3	3,000	1,204	(6) 1,000	(2) 4½	(1) ⅜x3	(3) ⅛x2	1,500
500	181	250	3½	540	3,613	.....	.....	(3) ⅜x3	(5) ⅛x3	4,000	1,806	(9) 1,000	(3) 4½	(2) ¼x3	(4) ⅛x2	2,000

(a) Cable, 5,000-volt, single-conductor, varnish cambric, double braid; size AWG or M cir. mil.
(b) Cable, 600-volt, single-conductor, paper-insulated, lead-covered; size AWG or M cir. mil.

Specially-Prepared Switch Copper by REVERE

Revere has developed a new method of manufacturing Switch Copper to meet the exacting requirements of the electrical industry on an economical basis.

The process produces Switch Copper with a surface finish far superior to regular commercial bar copper, and with exceedingly close tolerances. Flatness measured across the width of the bar is kept to the following Revere standards: — Convexity none. Concavity, .001″ maximum per side up to 2″ wide, .002″ per side, 2″ and over. Camber, or depth of lengthwise arc ⅛″ maximum in 8 feet. Edges are full rounded unless otherwise specified. Made from electrolytic copper, meeting the A.S.T.M. specifications for purity and conductivity.

This is really beautiful metal. Its superior finish and flatness mean that simple cutting and drilling are enough to produce switch blades that will make perfect contact, reducing current losses. Naturally, Revere Specially-Prepared Switch Copper carries a slight premium in price, but those who have used it report this is insignificant compared with the large savings made possible by abandoning the expensive finishing processes required when using ordinary commercial bar. Revere Switch Copper is also being used in: knife-blade fuses; switchboards; in other equipment requiring exposed bus bars. For further information, write Revere Executive Offices.

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METRIC UNITS AND EQUIVALENTS

Continuation of tabulated data for customary units of measurements used in United States and for metric units, covering classifications of volume, capacity, mass, and atmospheric and water pressure. Similar tables for classifications of length and area were published on page 108 in Electrical World, February 3, 1945.

Units listed are in common usage particularly in the electrical industry. Tables 5, 6, and 7 are adapted from Miscellaneous Publication M121 (1936) of National Bureau of Standards, Washington, D. C. Table 8 is adapted from British Standard 350 (1944) of British Standards Institution, London, England.

Table 5—Units of Volume

Units		Cubic Inches	Cubic Feet	Cubic Yards
1 cubic inch (cu.in.)	=	1	0.000,578,704	0.000,021,433,47
1 cubic foot (cu.ft.)	=	1,728	1	0.037,037,0
1 cubic yard (cu.yd.)	=	46,656	27	1
1 cubic centimeter (cm.³)	=	0.061,023,38	0.000,035,314,45	0.000,001,307,94
1 cubic decimeter (dm.³)	=	61.023,38	0.035,314,45	0.001,307,943
1 cubic meter (m.³)	=	61,023.38	35.314,45	1.307,942,8

Units		Cubic Centimeters	Cubic Decimeters	Cubic Meters
1 cubic inch (cu.in.)	=	16.387,162	0.016,387,16	0.000,016,387,16
1 cubic foot (cu.ft.)	=	28,317.016	28.317,016	0.028,317,016
1 cubic yard (cu.yd.)	=	764,559.4	764.559,4	0.764,559,4
1 cubic centimeter (cm.³)	=	1	0.001	0.000,001
1 cubic decimeter (dm.³)	=	1,000	1	0.001
1 cubic meter (m.³)	=	1,000,000	1,000	1

Table 6—Units of Capacity (Liquid Measure)

Units		Fluid Ounces	Liquid Quarts	Gallons	Milliliters	Liters	Cubic Inches
1 fluid ounce (fl. oz.)	=	1	0.031,25	0.007,812,5	29.572,9	0.029,572,9	1.804,69
1 liquid quart (liq. qt.)	=	32	1	0.25	946.333	0.946,333	57.75
1 gallon (gal.)	=	128	4	1	3,785.332	3.785,332	231
1 milliliter (ml.)	=	0.033,814,7	0.001,056,71	0.000,264,178	1	0.001	0.061,025,0
1 liter (liter)	=	33.814,7	1.056,71	0.264,178	1,000	1	61.025,0
1 cubic inch (cu.in.)	=	0.554,113	0.017,316,0	0.004,329,00	16.386,7	0.016,386,7	1

Table 7—Units of Mass (Greater than Avoirdupois Ounces)

Units		Avoirdupois Ounces	Avoirdupois Pounds	Short Hundredweights	Short Tons
1 avoirdupois ounce (oz. avdp.)	=	1	0.062,5	0.000,625	0.000,031,25
1 avoirdupois pound (lb. avdp.)	=	16	1	0.01	0.000,5
1 short hundredweight (short cwt.)	=	1,600	100	1	0.05
1 short ton (short ton)	=	32,000	2,000	20	1
1 long ton (long ton)	=	35,840	2,240	22.4	1.12
1 kilogram (kg.)	=	35.273,957	2.204,622,34	0.022,046,223	0.001,102,311,2
1 metric ton (t.)	=	35,273.957	2,204.622,34	22.046,223	1.102,311,2

Units		Long Tons	Kilograms	Metric Tons
1 avoirdupois ounce (oz. avdp.)	=	0.000,027,901,79	0.028,349,53	0.000,028,349,53
1 avoirdupois pound (lb. avdp.)	=	0.000,446,428,6	0.453,592,427,7	0.000,453,592,43
1 short hundredweight (short cwt.)	=	0.044,642,86	45.359,243	0.045,359,243
1 short ton (short ton)	=	0.892,857,1	907.184,86	0.907,184,86
1 long ton (long ton)	=	1	1,016.047,04	1.016,047,04
1 kilogram (kg.)	=	0.000,984,206,4	1	0.001
1 metric ton (t.)	=	0.984,206,40	1,000	1

Table 8—Units of Atmospheric and Water Pressures

Based on: 1 inch=25.4 millimeters
1,000,028 cubic centimeters of distilled water, at 4 deg. C. and 760 millimeters of mercury pressure, weigh 1 kilogram
1 pound=0.453,592,43 kilogram

Density of mercury at 0 deg. C.=13.595,5 grams per cubic centimeter
Values for head of water correct at 4 deg. C.; values for height of mercury correct at 0 deg. C.

Units		Pounds per Square Inch	Head of Water, in Feet	Inches of Mercury	Kilograms per Square Centimeter	Head of Water, in Meters	Millimeters of Mercury
1 pound per square inch	=	1	2.306,7	2.036,0	0.070,307	0.703,09	51.713
1 foot of head of water	=	0.433,52	1	0.880,67	0.030,479	0.304,8	22.419
1 inch of mercury	=	0.491,17	1.133,0	1	0.034,533	0.345,34	25.4
1 kilogram per square centimeter	=	14.223,3	32.809,3	28.958,2	1	10.000,28	735.54
1 meter of head of water	=	1.422,3	3.280,84	2.895,7	0.099,997	1	73.552
1 millimeter of mercury	=	0.019,337	0.044,606	0.039,37	0.001,359,6	0.013,596	1

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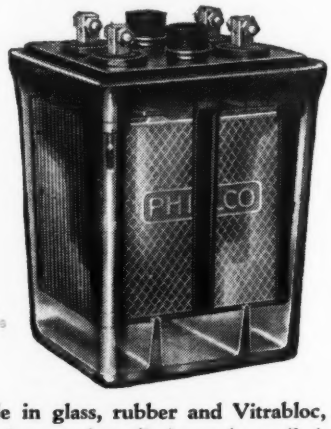

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Now available in glass, rubber and Vitrabloc, is the famous Philco Floté element that eliminates low cells in full float service, and materially reduces maintenance and charging costs.

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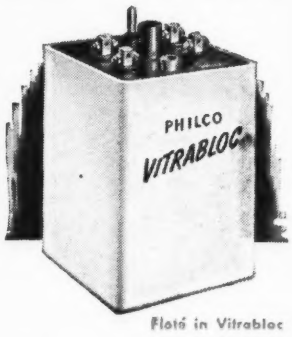

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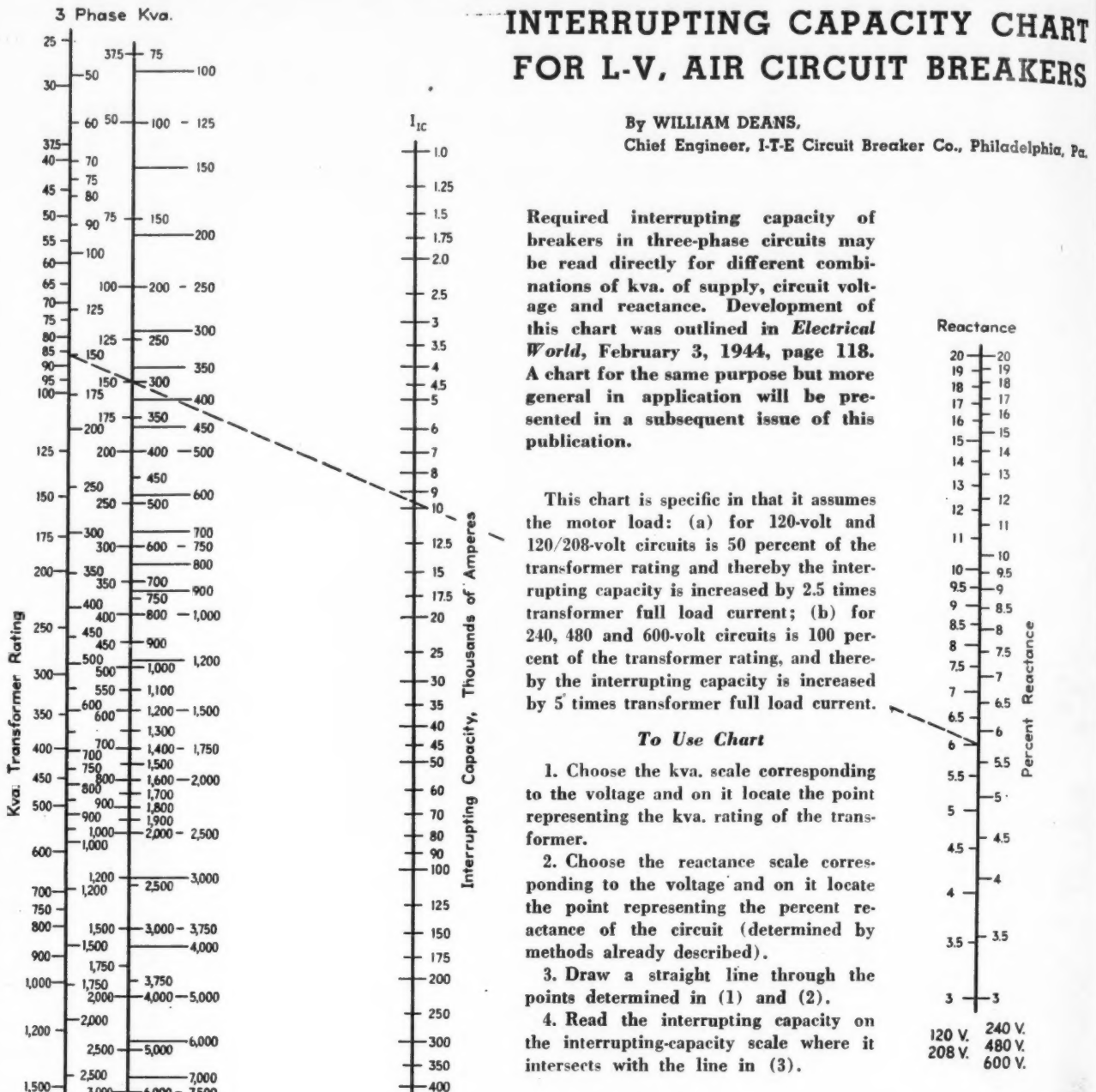
Specify PHILCO STORAGE BATTERIES

For 50 years a leader in Industrial Storage Battery Development

INTERRUPTING CAPACITY CHART FOR L-V, AIR CIRCUIT BREAKERS

By WILLIAM DEANS,
Chief Engineer, I-T-E Circuit Breaker Co., Philadelphia, Pa.

Required interrupting capacity of breakers in three-phase circuits may be read directly for different combinations of kva. of supply, circuit voltage and reactance. Development of this chart was outlined in *Electrical World*, February 3, 1944, page 118. A chart for the same purpose but more general in application will be presented in a subsequent issue of this publication.



This chart is specific in that it assumes the motor load: (a) for 120-volt and 120/208-volt circuits is 50 percent of the transformer rating and thereby the interrupting capacity is increased by 2.5 times transformer full load current; (b) for 240, 480 and 600-volt circuits is 100 percent of the transformer rating, and thereby the interrupting capacity is increased by 5 times transformer full load current.

To Use Chart

1. Choose the kva. scale corresponding to the voltage and on it locate the point representing the kva. rating of the transformer.
2. Choose the reactance scale corresponding to the voltage and on it locate the point representing the percent reactance of the circuit (determined by methods already described).
3. Draw a straight line through the points determined in (1) and (2).
4. Read the interrupting capacity on the interrupting-capacity scale where it intersects with the line in (3).

NOTES:

1. For unlimited primary supply, use for percent reactance, the reactance of the transformer plus the part of the secondary circuit to the fault, expressed in percent, with transformer rated kva. as base.
2. For limited primary supply, use for percent reactance:

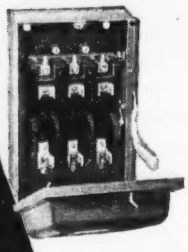
$$\%X_{TOTAL} = \%X_{SECONDARY} + 100 \times \frac{\text{Rated Kva. of Transformer}}{\text{Short Circuit Kva. of Primary Supply}}$$

In this expression $\%X_{SECONDARY}$ is the percent reactance defined in (1). Use $\%X_{TOTAL}$ as percent reactance in the chart.

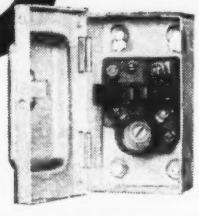
3. If reactances are known in per-unit (P.U.) values, convert to percent values by multiplying by 100: $\%X = 100 \times (P.U.)X$. Expression (2) becomes:

$$\%X_{TOTAL} = 100 \times \left((P.U.)X_{SECONDARY} + \frac{\text{Rated Kva. of Transformer}}{\text{Short Circuit Kva. of Primary Supply}} \right)$$

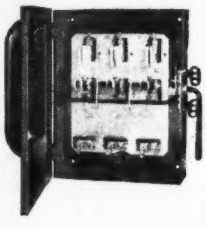
Square D's Complete Line of Safety Switches means the right switch for the job... every time!



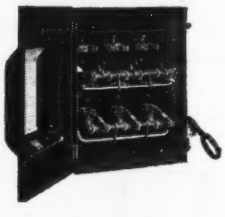
Type A Switches with concealed blades. Quick make, quick break and interlocked cover. Design permits smaller boxes with plenty of wiring space. Up to 200 amperes, 600 volts. H.P. rated. Made in 2 and 3 pole, 3 and 4-wire solid neutral.



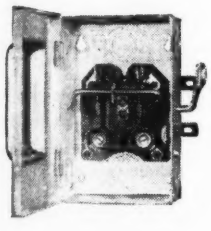
Blue Label Line—Type D Switches are compact, employing a rotary type of blade construction. Made for 2 pole and 2-wire and 3-wire, 230 volt A.C.-250 volt D.C. systems. Available for 30 to 60 ampere fusings. Front operated.



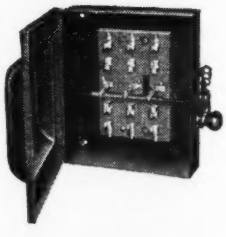
Type A Switches with visible blades. Quick make, quick break and interlocked cover; rated from 30 to 2400 amperes, up to 600 volts. Horsepower rated. Fusible and not fusible. 2, 3 and 4 poles and 3, 4 and 5-wire, solid neutral.



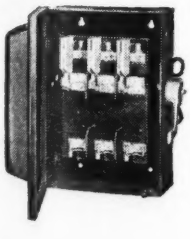
Manual Motor Starters are available up to 60 amperes, 575 volts A.C. horsepower rated. Auxiliary blades shunt running fuses when operating handle is moved to starting position. Releasing handle automatically moves blades to running position with fuses in circuit.



General Purpose Switches (Type D) are quick break only in capacities from 60 to 600 amperes inclusive. Thirty-ampere (and rain-tight) switches are not quick break. Made with 2, 3 and 4 pole and 2, 3, 4 and 5-wire s/n systems. 230 volt A.C. and 250 volt D.C.



Double Throw Switches. Made in sheet steel or explosion-resisting enclosures, approved for Class 1, Group D hazardous locations. Interlocked covers and quick make and quick break mechanism in sheet steel enclosures.



Type C Industrial Safety Switches are quick make and quick break. Made up to and including 600 amperes, 600 volt. Fusible and not fusible. Horsepower rated. 2, 3 and 4 poles, and 3, 4 and 5-wire solid neutral. Also available in rain-tight enclosures.

Weatherproof, dust-tight and **explosion-resisting enclosures** are available with ratings up to 200 amperes. Dust-tight switches approved for Class 11, Group G hazardous locations. Explosion-resisting enclosures approved for Class 1, Group D hazardous locations.

● Square D's unusually complete line of safety switches covers five divisions: *1.* Heavy Duty Industrial Type A. *2.* Intermediate Industrial Duty Type C. *3.* General Purpose Type D. *4.* Double Throw Switches. *5.* Manual Motor Starters.

See our catalog in SWEET'S or write for Safety Switch Bulletin. Address Square D Company, 6060 Rivard St., Detroit 11, Mich.

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DETROIT • MILWAUKEE • LOS ANGELES

Maintaining Station Bus "Alive"

There are several ways of maintaining an energized bus for station auxiliaries each having its inherent advantages. The manner of doing this, at the Glenwood Plant of the Long Island Lighting Co., Glenwood Landing, L. I., N. Y., is shown in the accompanying illustration. Here two buses (the essential and non-essential) are provided.

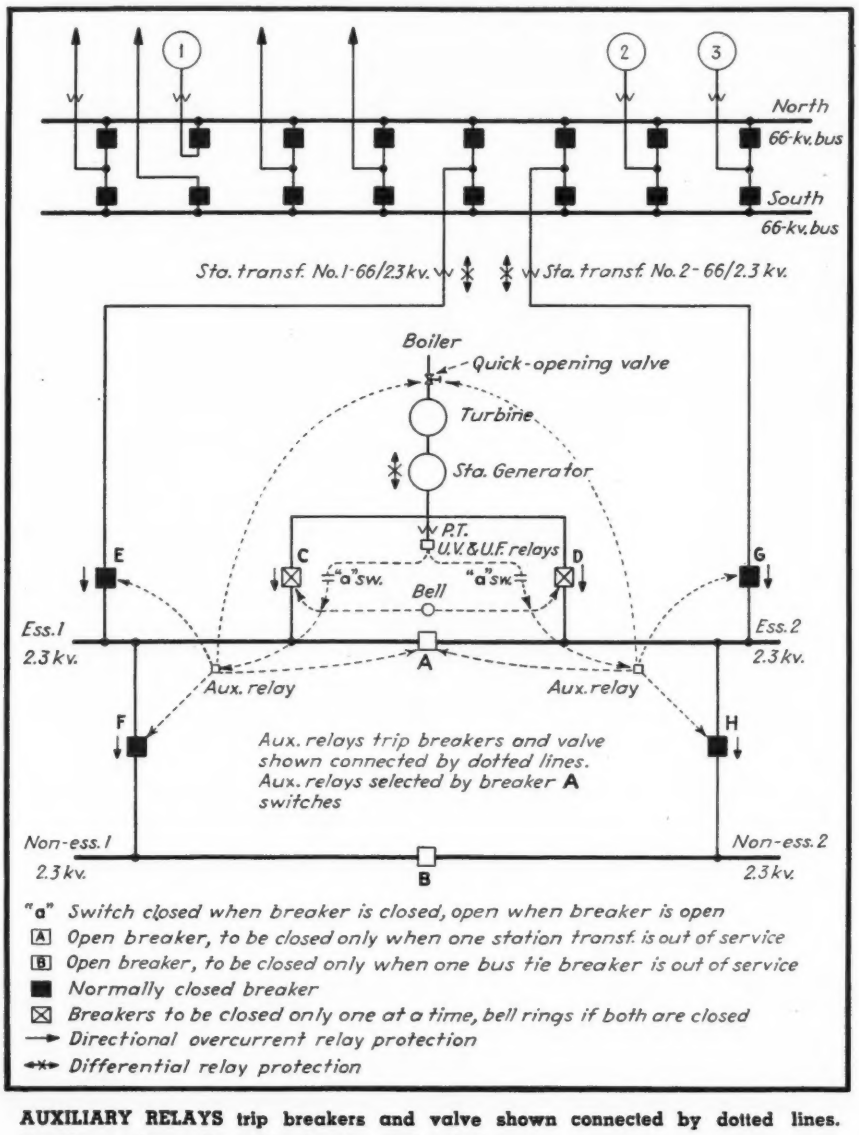
All auxiliaries necessary to the emergency operation of the boiler and generator are connected to the essential bus; all others are connected to the non-essential bus. The essential bus is divided into two sections which are connected through an oil circuit breaker. Each section carries the auxiliaries for one 75,000-kva. unit and its boilers and one section also has a 20,000-kva. unit. Either section may be considered as the essential section depending upon which unit is "on the line" or carrying the major portion of the load.

The reason for having the essential bus divided into two sections is that the steam driven station generator is not large enough to carry all the auxiliaries but is large enough to carry those for one unit. Since the station by design has facilities for storing pulverizing coal, the coal hoist, crushers and pulverizing mills are connected to the non-essential bus.

During normal operation the 3,750-kva. station generator is motoring and both the essential and non-essential buses are energized through the 66/2.3-kv. transformers and breakers A and B are open. Should unit No. 1 be considered the essential unit then oil circuit breaker C would be closed as would breakers E, F, G and H, and D would be open. In the event of a fault causing under voltage or low frequency "a" switch on left would close energizing the auxiliary relay, trip and circuit breakers E, F and H (if closed). The same operation would open the quick opening valve allowing steam to enter the turbine and drive the station generator which up to this instant had been motoring on the line. Thus, the essential auxiliaries have been segregated and kept in operation by the station generator.

After the fault has cleared and system voltage and frequency has returned to normal, the station service is brought back to normal by closing the breakers that opened during the operation and closing the quick-opening steam valve.

Should unit No. 2 be considered the essential unit, oil circuit breaker C would be opened and D would be closed since this unit's auxiliaries and its boiler auxiliaries are connected to the right of oil circuit breaker A. The operations in event of fault would be similar to those previously mentioned except that oil circuit breaker G and H would be involved and not E and F.



AUXILIARY RELAYS trip breakers and valve shown connected by dotted lines. Auxiliary relays selected by breaker "a" switches

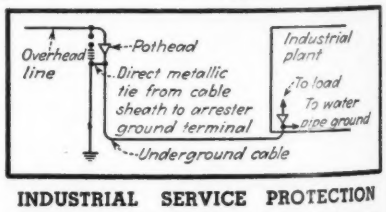
How to Protect Metering Equipment

III—Industrial Meter Protection

By R. F. QUINN*

Central Station Engineering Division, General Electric Co., Schenectady, N. Y.

Since any lightning impulses to which metering equipment in an industrial plant is subjected must come from the overhead line supplying the plant, consideration should first be given to the several ways in which a plant is normally supplied.

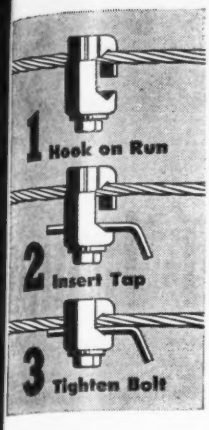


INDUSTRIAL SERVICE PROTECTION for plant supplied directly from primary system with no transformer bank external to the plant

A plant may be supplied directly from overhead lines with no transformer bank external to the plant, as shown in the diagram. This usually

* Series began in the ELECTRICAL WORLD, January 20, 1945, page 133.

SAVES MAN HOURS



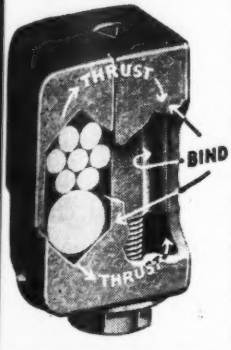
Easy to Handle

One-piece construction—always threaded—no time lost starting a nut—no chance of cross threading—no loose parts to lose.

Any standard wrench will fit. Only two bolt head sizes (3/8" and 9/16") for 8 sizes of Fargo Connectors, handling wires from No. 8 Solid to 4/0 Strand.

Bolt removable — convenient in making grounds and additional taps.

REDUCES SERVICE INTERRUPTIONS



HOW THE FARGO CONNECTOR "GRIPS LIKE A VISE"

1. High pressure at wire contact point develops terrific *vibration-proof bind* from inside thrust.

2. Small bolt, forged and rolled for extra strength, with precise, deep-rolled threads, means easy turning and high compression without stripping. Gives you not less than 10 lbs. compression between conductors for every inch-pound of wrench pressure. They'll take all the torque a lineman can apply, unless he's out with an oversize wrench, intent upon destruction!

Why Fargo Connectors are Dependable

Fargo Connector bodies and bolts stand up under extreme conditions . . . *climatic, mechanical, chemical and electrical.* Bodies are made of a tough copper-silicon-manganese alloy with a copper content of 96%. Bolts are made of a high strength copper-tin-silicon alloy with a copper content of 98%. Each metal was adopted as best for its specific purpose, after thorough tests over a long period.

These features, which produce durability and dependability, also mean high salvage value.

HOW FARGO ONE-PIECE CONNECTORS

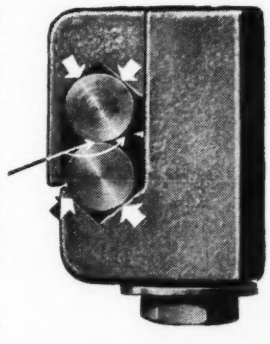
SAVE MAN HOURS, REDUCE SERVICE INTERRUPTIONS

HIGH CONDUCTIVITY— LOW VOLTAGE DROP

1. The V-Groove jaw construction guarantees four points of contact with the Connector, (see arrows) plus the wire-to-wire contact along a wide clamping area.

2. The tremendously high compression, obtainable even with low turning force, can produce a slight flattening of wires at point of contact, thus improving the conductivity.

3. The *massiveness* of the sturdy Fargo body helps carry current under overload conditions.



(Approved by Underwriters' Laboratories, Inc.)

For free catalog, application data and current information regarding speed of delivery, write or call any Line Material Company representative.

Fargo Connectors Available in Sizes No. 8 Solid to 1,000,000 CM

Full Fargo Line Distributed by

LINE MATERIAL COMPANY

Milwaukee, Wisconsin.

(*Representatives in principal cities*)

FARGO MFG. COMPANY POUGHKEEPSIE, NEW YORK

ESTABLISHED 1914

SOLDERLESS CONNECTORS • LINE SPLICES • ELECTRICAL SPECIALTIES

TWO NEW NAMES

1 G-E SLIMLINE fluorescent lamps

Several months ago, General Electric announced the G-E SLIMLINE—four new fluorescent lamps with unique new design and operating advantages. These slimmer fluorescent lamps, up to eight feet in length, promise a wealth of new lighting opportunities, especially in the commercial field.

G-E SLIMLINE lamps will be available in two diameters: three-quarters of an inch (42″ and 64″ long) and one inch (72″ and 96″ long). Other outstanding features: (1) instant starting, (2) long life, (3) higher efficiency—average of 60 lumens per watt, (4) operation singly, in multiple or in series and (5) operation over a range of current values from 100 to 200 milliamperes. Quantity production of G-E SLIMLINE Mazda Fluorescent Lamps will proceed as soon as conditions permit.

Suggestions for use of G-E SLIMLINE Lamps by William Edward Kapp, Detroit architect. Top: long, slim lines of light in elevator lobby (note also use of G-E CIRCLINE fluorescent lamps as elevator signal lamps). Above: Mr. Kapp's plan for general office illustrates how well G-E SLIMLINE Lamps are adapted to modern architectural treatments.

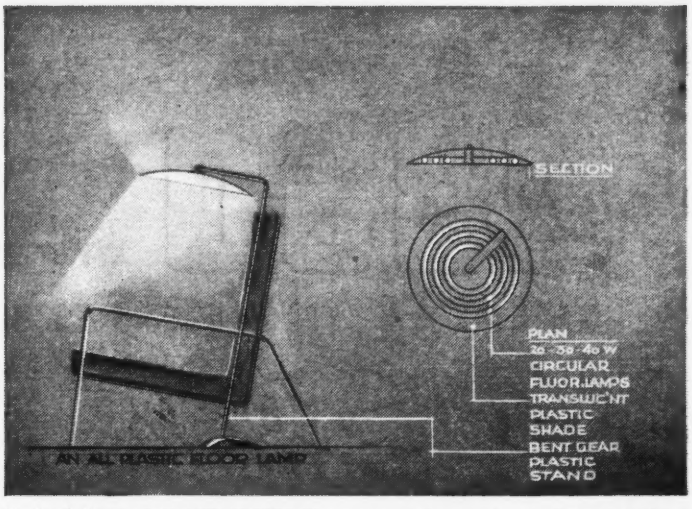
TO REMEMBER:

2 G-E CIRCLINE fluorescent lamps

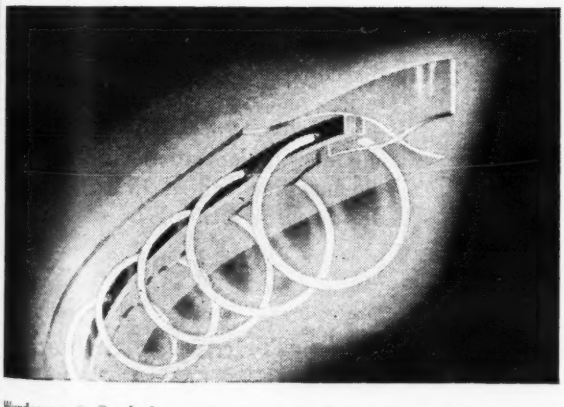
Architects commissioned by G-E to suggest creative ideas for postwar lighting, have been quick to take advantage of the dramatic new design opportunities afforded by G-E CIRCLINE Fluorescent Lamps. Examples are the illustrations on this page.

Present plans call for three circular lamps with approximate outside diameters of 8½, 12¼ and 16 inches. Bulb diameters are expected to range up to 1¼ or 1½ inches, and approximate watts from 15 to 50.

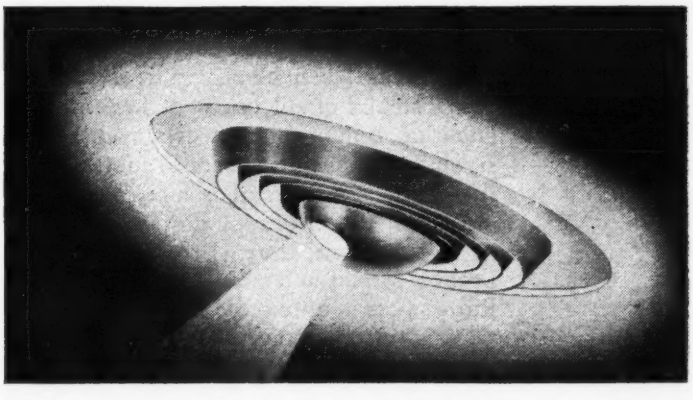
In addition to their use in commercial lighting applications, circular fluorescent lamps probably will find a place in portable and ceiling lamps for the home, either alone or in combination with filament lamps. Final design and production of G-E CIRCLINE Fluorescent Lamps will proceed when conditions permit.



Nest of three G-E CIRCLINE Fluorescent Lamps is used in this floor lamp. Shallow plastic shade gives maximum light. Design suggested by N. A. Owings, of Skidmore, Owings and Merrill, architects, Chicago.



Wurdeman & Becket, architects, Los Angeles, envision use of G-E CIRCLINE Lamps in this fixture for stores. Rings of light at regularly spaced intervals in ceilings are designed to direct customer traffic to rear of store. The cast phenolic reflector suggested here would help direct light down on the aisle.



Another Wurdeman & Becket design for a ceiling luminaire for stores, combining G-E CIRCLINE Lamp with filament lamps and spotlamp. At center is R-40 spotlight for dramatic highlighting of merchandise. Above it, a G-E CIRCLINE lamp illuminates bowl. Two 100-watt filament lamps, one on each side of center bowl, furnish general illumination.

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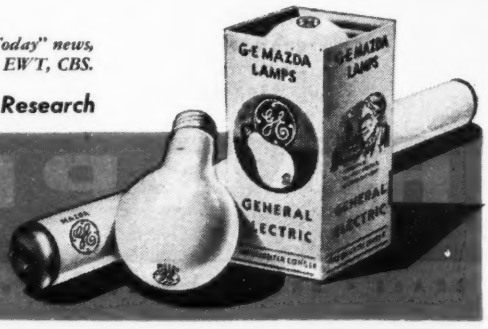
Hear the G-E radio programs: "The G-E All-Girl Orchestra", Sunday 10:00 p. m. EWT, NBC; "The World Today" news, Monday through Friday 6:45 p. m. EWT, CBS; "The G-E Houseparty," Monday through Friday 4:00 p. m. EWT, CBS.

"To make G-E Lamps STAY BRIGHTER LONGER" — The Constant Aim of G-E Lamp Research

G-E MAZDA LAMPS

GENERAL ELECTRIC



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is accomplished through a cable connection if the potential is 2,400 volts or higher. Lightning arresters should be applied to each phase wire at the junction of the exposed overhead lines and the cable. The arresters should be provided with a low resistance ground (5 ohms or less) at the cable riser pole. It is also of equal or greater importance to make a short direct connection from the arrester ground terminal to the cable sheath or armor. In addition, the industrial plant end of the cable sheath, if it is a 3-conductor cable, should be grounded to the water pipe system, the metering equipment ground, the conduit system and the frames of motors, controls, etc., in the plant. With this interconnection, the lighting arresters directly shunt the cable insulation they are protecting and the impulse voltage transmitted through the cable is limited to the stress allowed by the arrester, since the effect of the ground resistance is eliminated. Where the length of the cable entrance is 100 ft. or more, it is generally desirable to provide additional arresters at the terminals of apparatus at the substation end of the cable to prevent apparatus damage from reflections of the transmitted wave. This is particularly important where apparatus at the substation end may have sub-normal impulse strength or where rotating machines are directly connected to the cable service. In the case of rotating machines at the load end of the cable, protective capacitors should supplement the arresters at the machine end of the cable or at the machine terminals.

•

Vector Triangles Solved by Nomograph—II

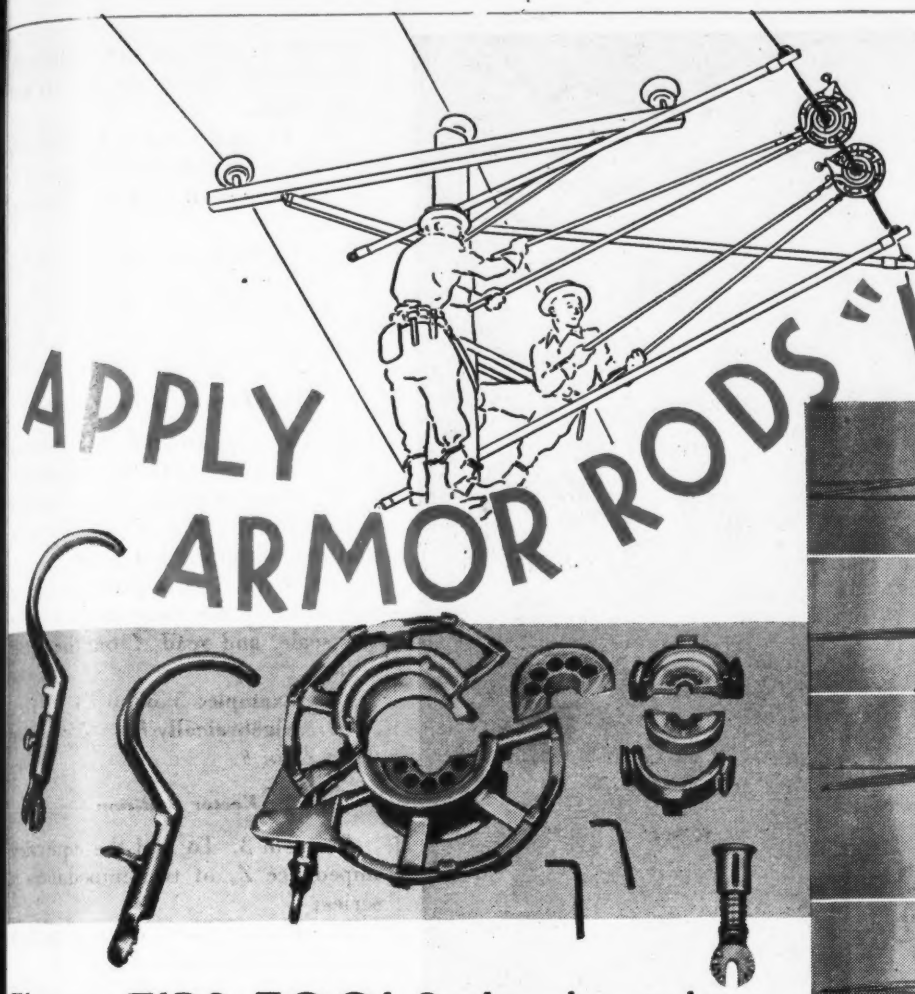
By W. W. EDSON
Head of Station Electrical Design
Boston Edison Co.

Several applications of the nomograph for solution of vector triangles (ELECTRICAL WORLD, February 3, 1945, page 110) are explained for electrical circuits.

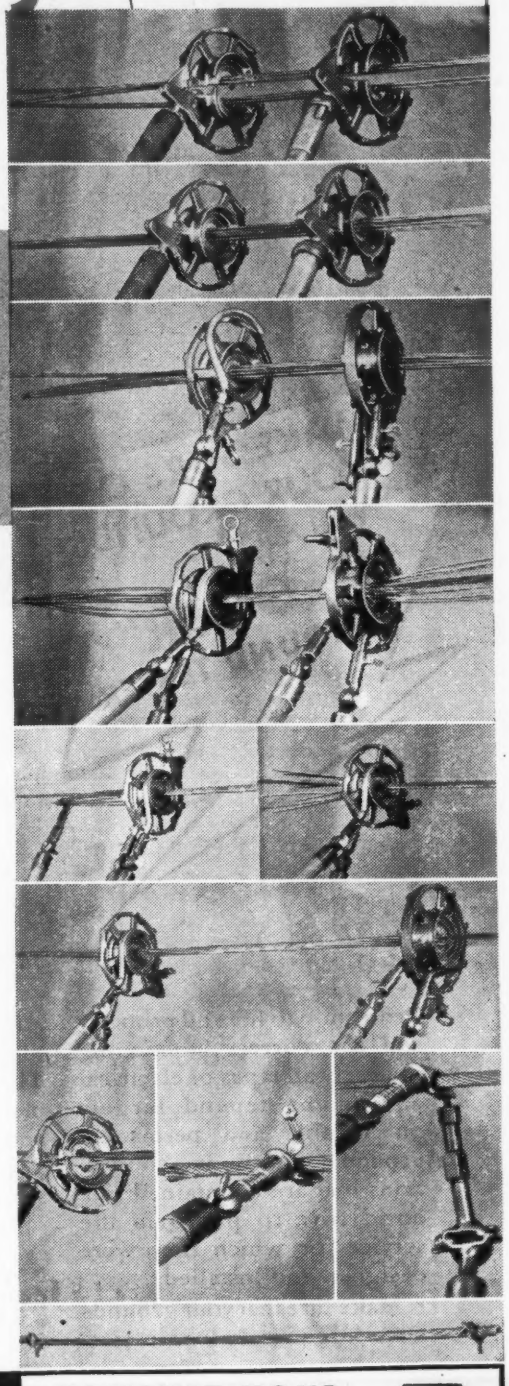
Coordinates of a Vector to Polar Form

Problem 1. To find the impedance from the resistance and reactance: $Z/\theta = R + jX$ (note $X = X_{inductance} - X_{capacitance}$). All expressed in ohms.

(a) Draw a line (or use a straight edge) from R value on the left scale



APPLY ARMOR RODS "HOT"



These TIPS TOOLS do the job without service interruptions

With this Tips Tool equipment, Armor rods of all standard sizes for cable ranging in diameter from .156 to 1.014 can be applied hot without service interruptions.

The application is shown in the series of illustrations at right. The dies are first inserted in the wheel-like die holder frames and armor rods threaded through the dies. In the first illustration, the rod is being placed over the conductor by the use of clamp sticks. The eye screws are then turned up by the clamp sticks to close the die over the conductor. Hooks, which are made to attach to a standard universal pole, are then hooked in position and the balance of the job consists of turning these wheels to twist the armor. Lugs on the hooks engage with lugs on the wheels and the wheels are turned, one clock-wise and one counter-clock-wise. After the center of the span is twisted, the wheels are moved to the ends and the job completed. Clamps are applied by a special device designed to hold armor rod clamps, and nuts are cinched with a hot line wrench.

The die holder wheels are made of cast aluminum for light weight. They are supplied with adapters for fitting them with smaller dies, thus they are applicable to all standard armor rod dies supplied by the Aluminum Company of America.

This equipment and method of applying armor rods hot is the result of numerous suggestions from the field. In fact, it is a combination of all the best features of the ideas considered. We believe it to be the most simple and practical method yet devised for application of straight armor rod. Write for more complete details of application.

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TIPS TOOLS

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Protection to life and property and the correct functioning of nearly all types of electrical equipment depend largely on suitable and permanent ground connections—connections that are maintained in a condition to perform the service for which they were designed and installed.

Make sure that your grounds have adequately-low resistance through the periodic use of a "Megger" Ground Tester. These instruments provide a method that is simple, quick and accurate—proved by their acceptance and years of service throughout industry.

★

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James G. Biddle Co.

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through X value on the center scale, and read the angle θ on the (t) scale at the right.

(b) Using R value as a pivot swing the line up to the same value of θ on the (s) scale, and read Z on the center scale.

(c) Example: $3 + j4 = Z\angle\theta$. Find $\theta = 53$ deg:, then $Z = 5$.

(d) Algebraically $Z^2 = R^2 + X^2$ and $\tan\theta = \frac{X}{R}$

Polar Forms to Coordinates

Problem 2. To find the resistance and reactance from the impedance:

(a) From θ on the (s) scale draw a line through Z of the center scale, and read R on the left scale.

(b) With R as a pivot swing the line down to the same angle θ on the (t) scale, and read X on the center scale.

(c) Example: $5\angle 53 = 3 + j4$.

(d) Algebraically $R = Z\cos\theta$ and $X = Z\sin\theta$.

Vector Addition

Problem 3. To find the equivalent impedance Z_s of two impedances in series:

(a) Reduce both vectors to their coordinate form as in (2).

(b) Add the coordinates, as:

$$Z_1 = R_1 + jX_1$$
$$Z_2 = R_2 + jX_2$$
$$\overline{Z_s = (R_1 + R_2) + j(X_1 + X_2)}$$

(c) Find $Z_s\angle\theta_s$ for these sums of resistances and reactances as in (1).

(d) Example:

$$5/\underline{53} = 3 + j4$$
$$5.66/\underline{45} = 4 + j4$$
$$\overline{10.60/\underline{49} = 7 + j8}$$

Reciprocal to Vector

Problem 4. To find admittance in mhos which equals the reciprocal of impedance in ohms, and vice versa:

$$\left(\frac{1}{Z/\underline{\theta}}\right) = Y/\underline{-\theta}$$

(a) Express the vector in polar form as in (1).

(b) Calculate the reciprocal.

(c) Proceed as in (2), that is, from θ_s to the admittance Y in center and read conductance G on the left. Using G as a center lower the line to θ_t and read susceptance B in the center. Note this value B is negative since the angle was negative.

(d) In this case, or in others, it may be necessary to divide the left and center scales together by 10 or 100, etc. to stay on the chart.

(e) Example: $Z\angle\theta = R + jX$;

Know-how!

BULLDOG BUStribution DUCT

MANUFACTURERS, large and small, turn to BullDog for the real "know-how" in electrical distribution.

This is only natural, for BullDog pioneered plug-in power and lighting systems, and has introduced every important new improvement.

Three modern BullDog DUCT systems, the most widely used in industry, provide complete versatility and flexibility of power and light for every type of industrial application.

BUStribution DUCT (illustrated above) for plug-in power at any point—Industrial Trol-E-Duct for portable tools, cranes, hoists and other "moving loads"—Universal Trol-E-Duct for completely flexible lighting.

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Write for our illustrated bulletins for detailed information. Or, better yet, our expert staff of conveniently located field engineers will welcome an opportunity to work with you on your electrical distribution problems.

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These special plus values are the result of accumulated engineering experience that has lived close to the Utilities for nearly half a century and to a new and varied experience gained in our government war construction assignments.

When Victory is ours and we can all turn once again to civilian production, from devoting our energies to winning the war, which of course is *first* now, "American" will produce equipment that will most completely meet every requirement for the many postwar jobs. Be prepared by using The American Coach Replacement Plan—Write for Details Today—

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$5\angle 53 = 3 + j4$; then $Y\angle -\theta = G - jB$; $0.2\angle -53 = 0.12 - j0.16$.

Algebraically $G_1 = \frac{R}{R^2 + X^2}$

and $B = \frac{X}{R^2 + X^2}$

Impedances in Parallel

Problem 5. To find the equivalent impedance Z_p of two impedances in parallel:

(a) Find the reciprocals of the two impedances as in (4) and add, thus

$$\left(\frac{1}{Z_1}\right) = Y_1 = G_1 - jB_1$$

$$\left(\frac{1}{Z_2}\right) = Y_2 = G_2 - jB_2$$

$$\frac{1}{Z_p} = Y_s = (G_1 + G_2) - j(B_1 + B_2)$$

(b) Find Y_s on the center scale using the G and B sums on the left and center scales similar to (1).

(c) The equivalent Z_p equals the reciprocal of this Y_s as in (4). Note the sign is again reversed to positive.

(d) Example: Reciprocals of the two impedances in (3d) are:

$$\begin{array}{l} Y_1 = 0.12 - j0.16 \\ Y_2 = 0.125 - j0.125 \\ \hline Y_s = 0.245 - j0.285 \\ Z_p = 2.66/\underline{49.5°} \end{array} = 0.376/\underline{-49.5°}$$

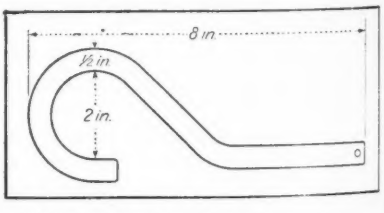
(e) Algebraically $Z_p = \frac{Z_1 \times Z_2}{Z_1 + Z_2}$

(Calculations must be considered vectorially.)

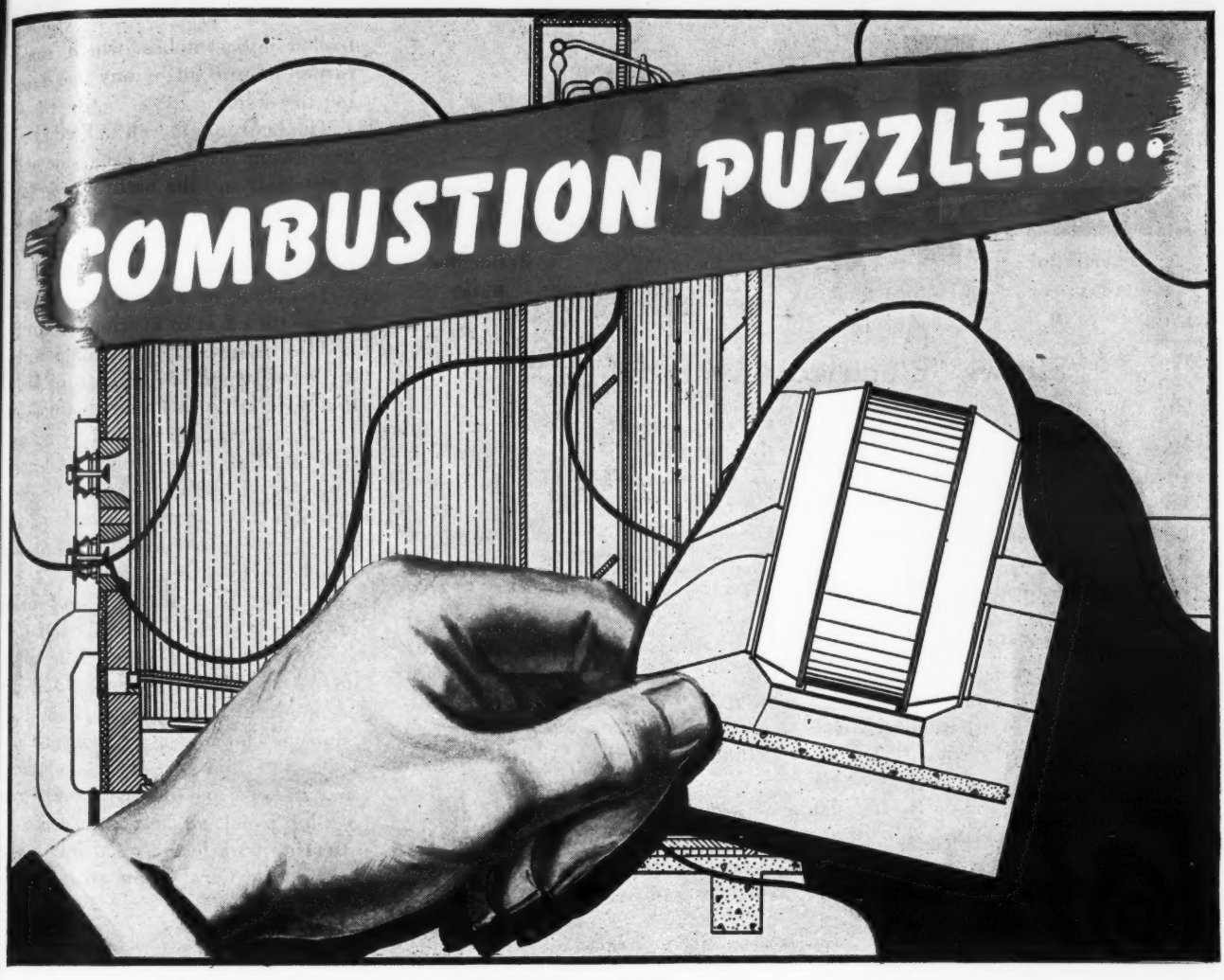
•

Odd Shaped Hanger Increases Safety

Question-mark-shaped hook made out of fiber board makes an easy quick and versatile hanger for rubber blankets and protective boards to isolate live leads or buses from the workmen. Tie strings of the blanket or board are attached to the device by strings through the hole at one end. With one of these at each corner, the blanket is hung up by hooking the question mark over a pipe, angle iron or nail, as is done at the Freeport Municipal Plant, Freeport, L. I., N. Y.



FIBER-BOARD hook for hanger



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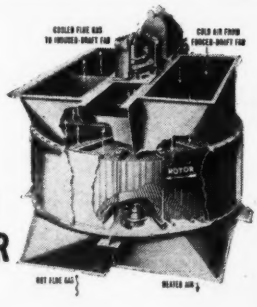
Combustion puzzles presented by today's fuels are among the problems which *preheat engineering* may be able to solve for you.

Helping keep combustion efficiency high is the business of our "preheat engineers". So, if you are faced with a problem of bettering combustion through heat recovery, these engineers are at your service, regardless of whether or not you are now a user of the Ljungstrom Air Preheater.

If you plan to modernize your steam generating plant, or to build a new one, it's to your advantage to call in a preheat engineer while plans are still in the formative stage. And for many problems of gas-to-air or air-to-air heat exchange in process applications, our staff can offer new ideas.

THE LJUNGSTROM AIR PREHEATER



The continuous, regenerative, counterflow principle of the Ljungstrom Air Preheater provides maximum heat transfer with minimum weight and size. The rotating, cylindrical heat transfer surface, "soaks up" heat in the gas chamber, then rotates into the chamber where it gives up this heat to the entering air.

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Residential
Rural

Shows "Electrical Living in 194X"

A wiring display which tells the Westinghouse story of "Electrical Living in 194X." recently was placed on exhibition at Omaha by the Nebraska Power Co. to emphasize the necessity of adequately planned wiring in the postwar homes of tomorrow.

It consists of three front and two end panels; atop the center section is a scale model of a modern five room house, which is well lighted and calls attention to the display. Below, on the center panel, is a blowup of the electrical home of 194X. On the plan is shown the wiring diagram for the whole house as well as an explanation of why certain circuits, outlets, and switches are used in each room.

The left front panel has centered in it a recessed cross section of a modern six-room home built to scale. This home is completely furnished to the last detail. Both appliances and furniture are built to scale. A sign above this cutaway says "everybody's going all electric in 194X". An inverted horn of plenty is dumping post-war appliances through the roof into the house.

In the basement on the right is the heating and air-conditioning unit, the Precipitron and the home freeze cabinet. On the left is a modern laundry complete with water heater, laundromat, dryer, ironer, work surfaces and cabinets. Lighting for the basement is controlled by a master switch on the side of the panel.

The kitchen houses a range, refrigerator, dishwasher, sink, work surfaces and cabinets with fluorescent lighting, a clock and a ventilating fan. Even the tiny floor and table lamps light up in the living room. A tiny radio-television set has an illuminated screen with a scene on it. Lighting for these appliances, too, are controlled by switches which can be turned on and off by any one inspecting the display.

The bedroom is well lighted even to fluorescent lamps on each side of the vanity mirror; the bathroom includes a sunlamp, an infra red heater and is well lighted; even the attic has a built-in exhaust fan that runs.

The right-hand front panel demonstrates the effect of overloaded circuits and low voltage. Inadequate wiring is demonstrated by a pair of lamps that burn dimly, a motor that does not come up to full speed and by a range element that glows dimly. Adequate wiring shows lights that burn brightly, a motor that reaches speed quickly and a range element that instantly reaches a fiery red.

Installed on one of the end panels are a number of wiring devices with an explanation of each. The entire display uses Reddy Kilowatt and cuts of modern electrical appliances to good advantage. The fact that the lights and appliances can be operated by any one passing by makes it a display which attracts a good deal of attention and does a good job of telling the electrical home story.

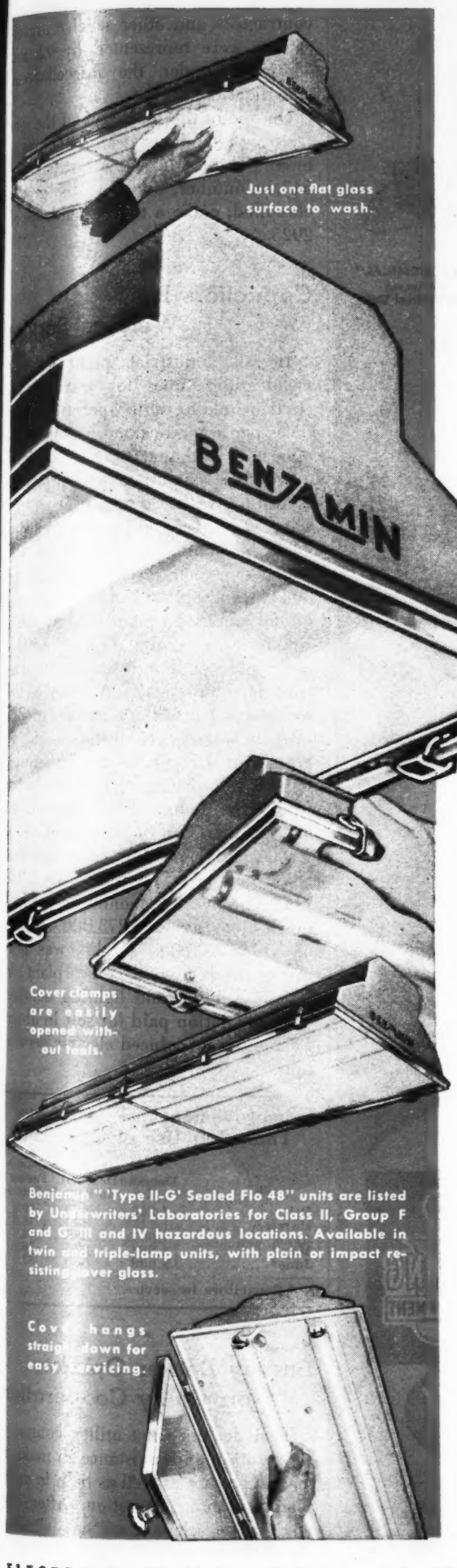
DISPLAY PIECE for demonstrating tomorrow's electrical home

•

Indication of Interest in H. F. Heating

Analysis of attendance at the recent high frequency heating conference sponsored by the Great Lakes Power Club in cooperation with the Chicago Lighting Institute shows the wide interest in this new industrial tool and indicates its potentiality as a post-war load builder. Of the total attendance of nearly 3,000, less than one quarter were people registered as in the electrical industry. The others were mostly users or possible users of high frequency heating equipment.

The electrical industry group divides into two parts, 388 representing utilities and 399 manufacturers. Heavy and light metal manufacturing registered 364 and 285 respectively, while manufacturers of wood, chemical and miscellaneous products had 122, 121 and 106 in attendance. From food processors came 171; from transportation companies, and makers of transportation equipment, 118; from educational institutions and trade associations, 96; government agencies, 53. Consulting engineers,


Just one flat glass surface to wash.
BENJAMIN
Cover clamps are easily opened without tools.
Benjamin "Type II-G" Sealed Flo 48" units are listed by Underwriters' Laboratories for Class II, Group F and G, III and IV hazardous locations. Available in twin and triple-lamp units, with plain or impact resisting cover glass.
Cover hangs straight down for easy servicing.

Specify Benjamin SEALED-FLO *Fluorescent* LIGHTING UNITS

✓ ***For More Light*** *in departments with adverse atmospheric conditions*

✓ ***For More Easily Sustained High Lighting Levels***

✓ ***For Simplified Maintenance***

To secure the advantages of fluorescent lighting where combustible dusts in the atmosphere may create fire and explosion hazards and where maintenance due to dirt and vapor is a problem, specify Benjamin Type II-G "Sealed-Flo 48" units.

Dust-Tight and Vapor-Tight

These extremely durable, porcelain enamel fixtures, with their one-piece steel reflector and special type glass cover seal the interior against dust and dampness. All that is required to maintain the rated output of these units is cleaning the cover glass and re-lamping when needed. Exclusive Benjamin constructions embodied in these units reduce maintenance time to a minimum. Cover clamps are easily opened by hand; hinged cover facilitates re-lamping.

High Lighting Efficiency

In general lighting installations, Twin-Lamp Sealed-Flo units provide lighting levels ranging from 20 to 48 footcandles at normal mounting and spacing. Triple-lamp units provide approximately 28 to 65 footcandles. These units are also widely employed for local lighting of inspection tables, production lines and machines. Twin-Lamp units provide up to 100 footcandles and Triple-Lamp units up to 135 footcandles for such applications.

Listed by Underwriters' Laboratories for Certain Locations Requiring Dust-Tight or Vapor-Tight Lighting Units

These units satisfy all Underwriters' requirements for Class II, Group F and G hazardous locations, Class III and IV locations. They are available on the same priorities as other industrial fluorescent and incandescent equipment. For further details and complete data on these units

Write for free Data Bulletin today

Benjamin Electric Mfg. Co.

Product Information Department K Des Plaines, Illinois

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Fluorescent
Industrial Unit
SILV-A-KING
PORCELAIN ENAMELED
fluorescent units
KEEP ON GIVING MORE EFFICIENT LIGHT!
Long after other types of fluorescent units have lost their ability to deliver their original high standard of illumination, SILV-A-KING equipment will still be there . . . lighting the way to higher production. It's the kiln-fired Porcelain Enameled finish that does the trick. What's more, SILV-A-KING units cost less to maintain than any other lighting fixtures on the market!
"SPECIFICATION"
Fluorescent
Industrial Unit
Write for Bulletins 44FE and 44FS describing the "Economical" and "Specification" units.
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LIGHTING EQUIPMENT
BRIGHT LIGHT REFELECTOR COMPANY
Metropolitan & Morgan Avenues, Brooklyn 6, New York

contractors and other service organizations were represented by 92, and 74 came under the miscellaneous classification.

On one of the four days of the conference attendants were not registered. Those who came on that day, 540 in number, added to the groups classified, make a total attendance of 2925.

•

Capacitors Help Welders Service

In an industrial plant making metal radio tubes for war service, electric welding units operating many times per second caused heavy fluctuations in load that were detrimental to voltage regulation, and produced demands with low power-factors. The welding equipment included about 550 units ranging between 0.5 and 1 kva. each, three 175-kva., three 50-kva. and six 25-kva. welders, and a total connected plant load of about 1,000 kw. About 75,000 kw.-hr. were sold per month to other industries on the premises. A study of the conditions led to the purchase of 225 kva. in capacitors installed in 15 groups of 15 kva. each. The result was an improvement of power-factor from a minimum of 69.9 percent to 82 percent, on an investment of about $2,000 in capacitors, the demand being cut from 1,243 kva. to 1,038 kva. The average monthly consumption of energy was 273,000 kw.-hr., of which 200,000 kw.-hr. was normally used by the tube plant in power, welding and lighting service. The installation paid for self in about 14 months in reduced electric service bills.

Improvement in Power-Factor Following Use of Capacitors

	Demand in Kva.	Demand in Kw.	Power-Factor in Percent
Feb.	1,243	868	69.9
March	1,115	330	74.4
April	1,097	808	74.6
May	1,083	825	76.1
June*	1,038	850	82.0

* Capacitors in service.

•

Survey Dealer Opinion on Utility Cooperation

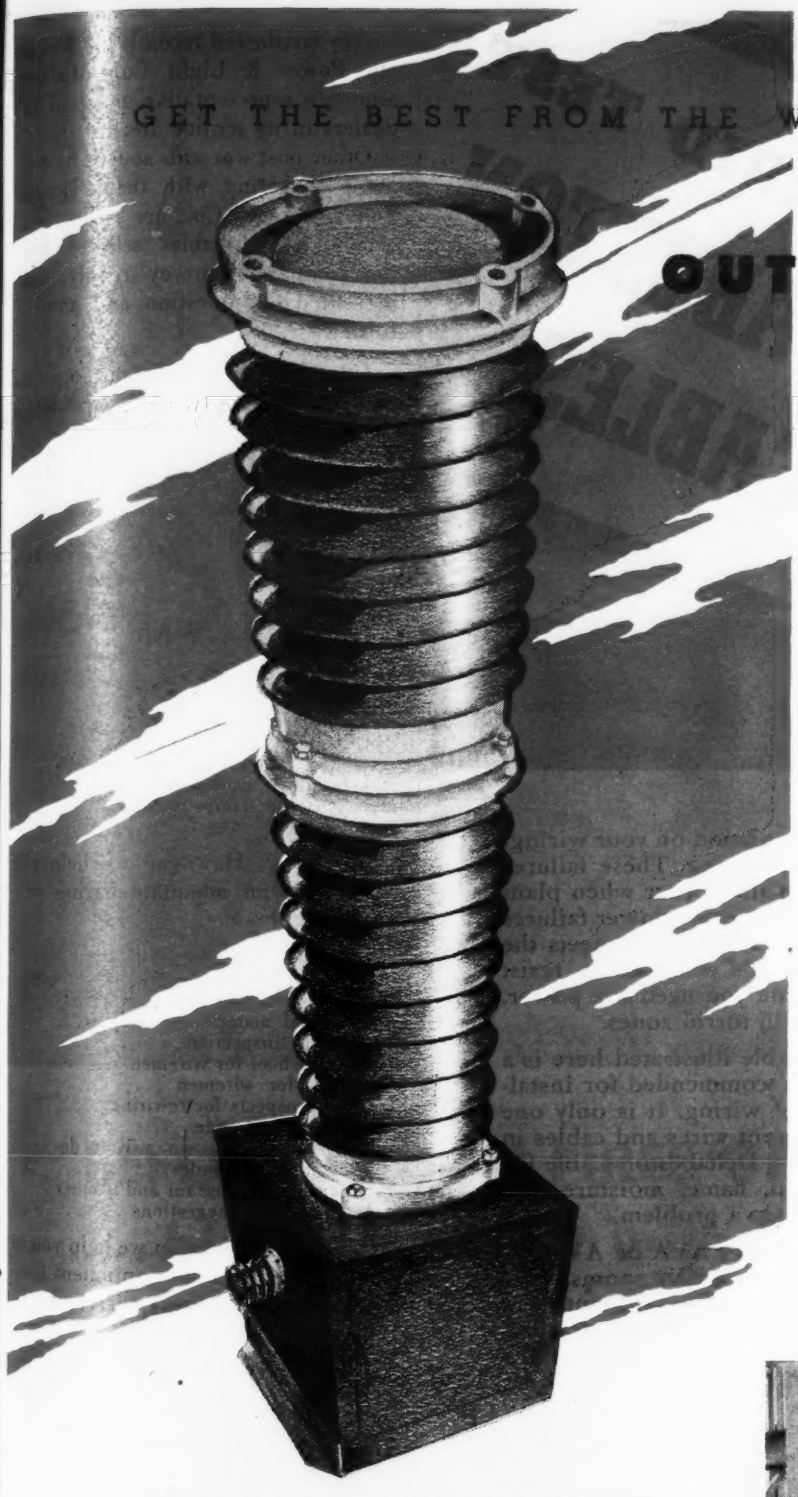
That dealers want utility company cooperation and assistance in making market studies as well as help in sales planning and promotion, after the war, seems clear from an opinion

GET THE BEST FROM THE WORLD'S LARGEST

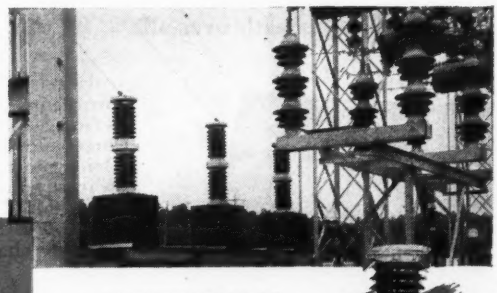
OUTSTANDING!

C-D leadership gives you a better carrier current coupling capacitor

Typical of Cornell-Dubilier's outstanding improvements in capacitor quality and design is the enlarged and superior Type CA unit for carrier current coupling. Type CA's fog-type petticoats provide a large creeping distance between terminals . . . are designed for low resistance at high frequencies. Galvanized malleable iron mounting flanges permit stacking for high voltage connection. Base and top are specially sealed for leakproof service and new inner construction gives great tensile strength. Investigate this improved type of carrier coupling capacitor. Your local C-D field engineer will be glad to answer questions or write Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.



.001 mfd. 76 Kv outdoor coupling capacitor with mounting base containing drain coil gap and shorting switch



AN INSTALLATION OF TYPE CA CAPACITORS *for coupling carrier communication and signalling on a 110,000 volt, 3 phase grounded neutral line. Each capacitor is rated 76,000 volts. The base is large enough so that auxiliary potential equipment may be mounted.*

CORNELL-DUBILIER CAPACITORS

FOR POWER FACTOR IMPROVEMENT
CARRIER CURRENT COUPLING
SURGE PROTECTION

When heat bakes out the insulation on your wiring, power fails and motors stop running. These failures can be serious. Particularly if they occur when plant operations are at peak load. Don't risk power failures with ordinary cables. Rely on a cable that meets the torrid test. Use Deltabeston. It's designed to resist intense heat . . . just the cable you need for power, lighting and control circuits in torrid zones.

The Deltabeston Power Cable illustrated here is a three-conductor Type AVA recommended for installations in conduit or exposed wiring. It is only one of more than a hundred different wires and cables in the Deltabeston line. There's a Deltabeston Cable for every installation where heat, flame, moisture, oil, grease and corrosive vapors are a problem.

Deltabeston Power Cable Types AVA or AVL are ideal for wiring in power plants, boiler rooms, steel mills and in other installations where constant high temperatures prevail. It is insulated with felted asbestos, varnished cambric insert and asbestos braid or lead sheath over-all.

Here's the answer to your wiring problems. You can obtain a copy by writing to Section Y253-9, Appliance and Merchandise Department, Bridgeport, Connecticut. Deltabeston Wires and Cables are distributed nationally by Graybar Electric Company, G-E Supply Corp., and other G-E Merchandise Distributors.

BUY WAR BONDS AND KEEP THEM

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS.

GENERAL ELECTRIC

survey conducted recently by Wisconsin Power & Light Co., Madison, among a representative group of 163 dealers in its service area.

Other post war aids sought by dealers cooperating with the Wisconsin Power & Light Co., are indicated in accompanying tables selected from the company's survey report; here presented "in question and answer" form.

Question: What, in your opinion, is the market that needs first attention?

	Frequency
Washing machines; laundry equipment	15
Refrigeration	14
Appliances	7
Ranges	5
Freezers	5
Water systems	5
Water heaters	3
Farm equipment	3
Milking machines	2
Radio	2
Irons	2

Ironers, motors, cleaners, oil burners, stokers, milk coolers, pump jacks and portable lamps received one "vote" each.

Question: How can we help you most with an adequate wiring program?

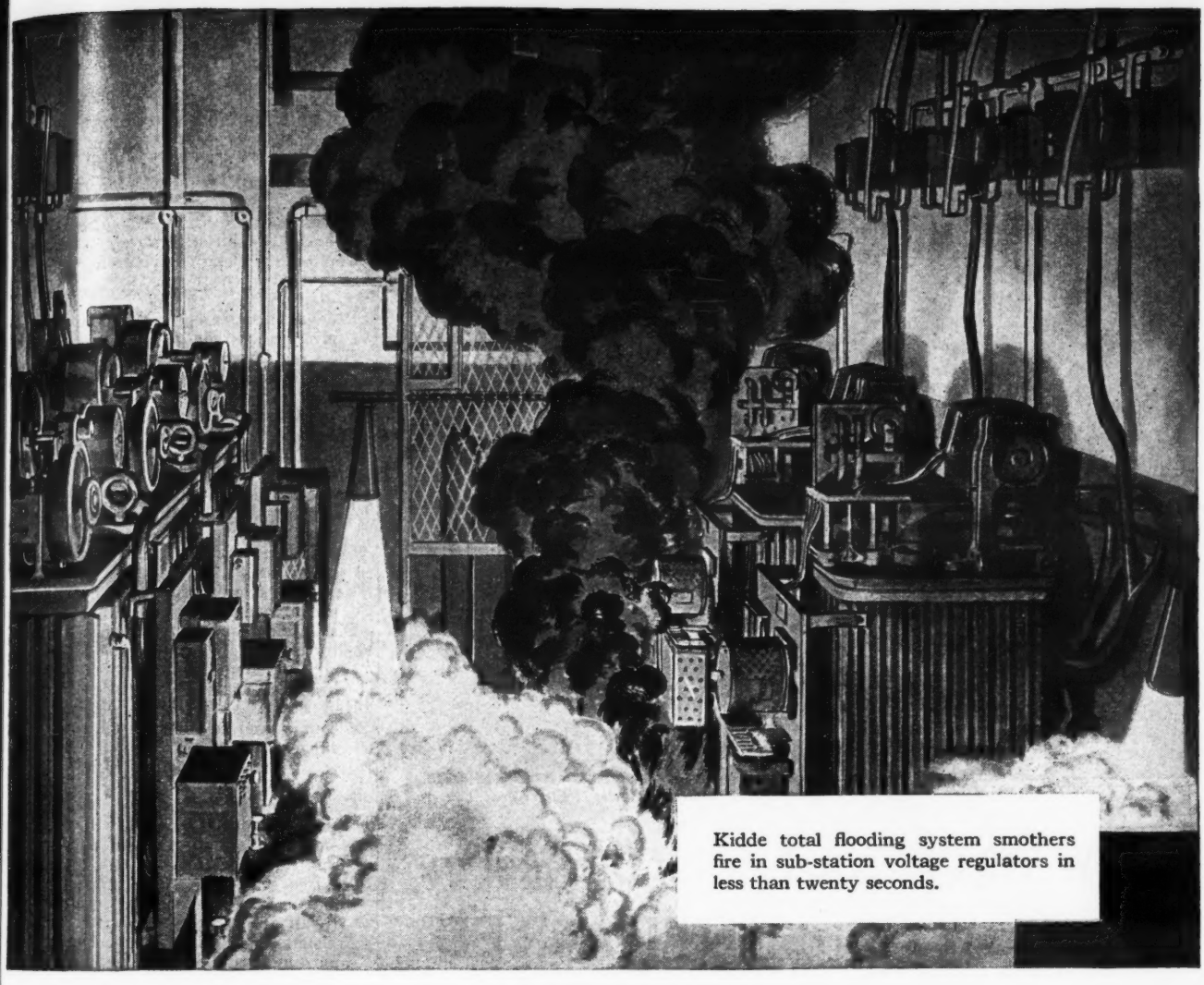
	Frequency
Advertising	9
Promotional material	8
More rigid inspection	5
Training school for wiremen	3
Licensing for wiremen	3
Provide prospects for rewiring	2
Simplify wiring code	2
Supply information on wiring developments and codes	2
Promote safety program and 9 other non-recurring suggestions	2

Question: How can we help you in securing commercial equipment business such as lighting, refrigeration and air conditioning?

Continue dealer cooperation	8
Engineering assistance	6
General advertising	5
Do not handle commercial equipment	2
Supply prospect lists	2
Direct mail	2
Trial basis	1
Distribute literature on dealers' merchandise	1
Train dealer salesmen	1
Educational meetings	1
Promote air conditioning	1

Question: How can we help you in the rural territory?

List new customers as lines are built	13
General promotional advertising	9
Direct mail	4
Promote line extensions	4
Supply names of all rural customers	2
Direct contact by salesmen	2
Educational meetings	2
Promote water systems	2
Promote adequate wiring	2
Continue "Electricity on the Farm"	



Kidde total flooding system smothers fire in sub-station voltage regulators in less than twenty seconds.

BEFORE TOUGH FIRES GET TOO TOUGH

...blast them out with Kidde!

KIDDE KILLS TOUGH FIRES

The fires that break out in sub-stations are really tough to fight—but Kidde built-in systems bring them quickly under control by smothering them under a blanket of dry, inert, non-conducting carbon dioxide.

There's no damage to insulation or water-soaking of apparatus when you use Kidde equipment—it limits the loss to the point of rupture. Equipment is back in service with the minimum of interruption.

Generators and other rotating machinery, switchgear, condensers, regulators and other electrical apparatus are all protected with equal efficiency by Kidde equipment. Remember, too, that all laboratories approve Kidde equipment for fighting class B fires in flammable liquids as well as for class C electrical fires. Install Kidde equipment for the protection of such hazards as flammable liquid storage and oil reclamation rooms — to give *complete* protection throughout your plant. Call in a Kidde representative for advice on the selection of equipment for each tough-fire area in the accompanying list. Write today.

Generators
Motors
Condensers
Converters
Transformers
Switchgear
Lightning Arresters
Rectifiers
Regulators
Flammable Liquid Storage
Filter Recirculation

Walter Kidde & Company, Inc. • 140 Cedar Street, New York 6, N. Y.

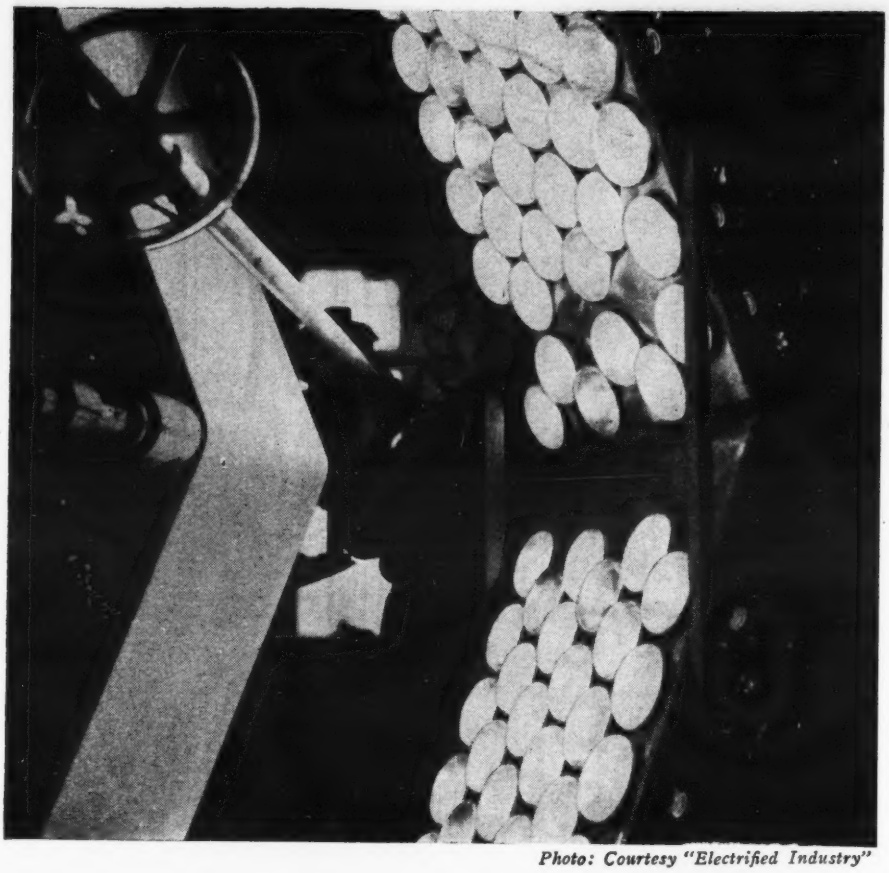


Photo: Courtesy "Electrified Industry"

HOW TO DRY OUT A *wet blanket in* 3 MINUTES with INFRA-RED

Here's how to dry out a wet blanket (of felt, used in the White Bros. plant to "blot" fabric in the Sanforizing process): These INFRA-RED Heat Lamps, reflector type, dry it 100% faster than former methods—because INFRA-RED heat penetrates deep into the substance and works rapidly to the surface. Think of drying anything from the inside out! Scientific INFRA-RED Heating—efficient, rapid, inexpensive — may well find an application in your plant!

BIRDSEYE INFRA-RED HEAT LAMPS

Birdseyes are standard for most infra-red tunnels, ovens, and other production line installations. There is no mystery or hocus-pocus about the realy dramatic results possible with Infra-Red. However, Infra-Red Heating is a science, and, for maximum efficiency, *Birdseye Lamps should be used with scientifically engineered equipment.* We will gladly furnish names of manufacturers of such equipment.

WABASH APPLIANCE CORPORATION

345 Carroll Street, Brooklyn 31, N. Y.

and 14 other non-recurring suggestions 2

Question: How can the fullest cooperation be developed between dealers and the electric company?

On Company Policy

Satisfied with present cooperation policy	22
Discontinue selling merchandise	8
Company to sell aggressively	2
Company is clean competition	2

On Dealer Cooperation

Promote dealer program; standardize prices and trade-in practices	17
Have regular dealer meetings	9
Company salesmen to sell ideas only, refer prospects to dealers	7
More assistance from home advisors	6
Eliminate knocking of dealers products and chain store products by company salesmen and employees	4
Introduce new developments only	3
Company salesmen to help dealers close sales	3
Company to carry dealers time-payment sales	3
Company salesmen to sell only low acceptance items	2
Discontinue long-term payment contracts	2
Company should not handle same brand as dealers	3
Help restrict dealerships to legitimate sources and 26 other non-recurring suggestions	2

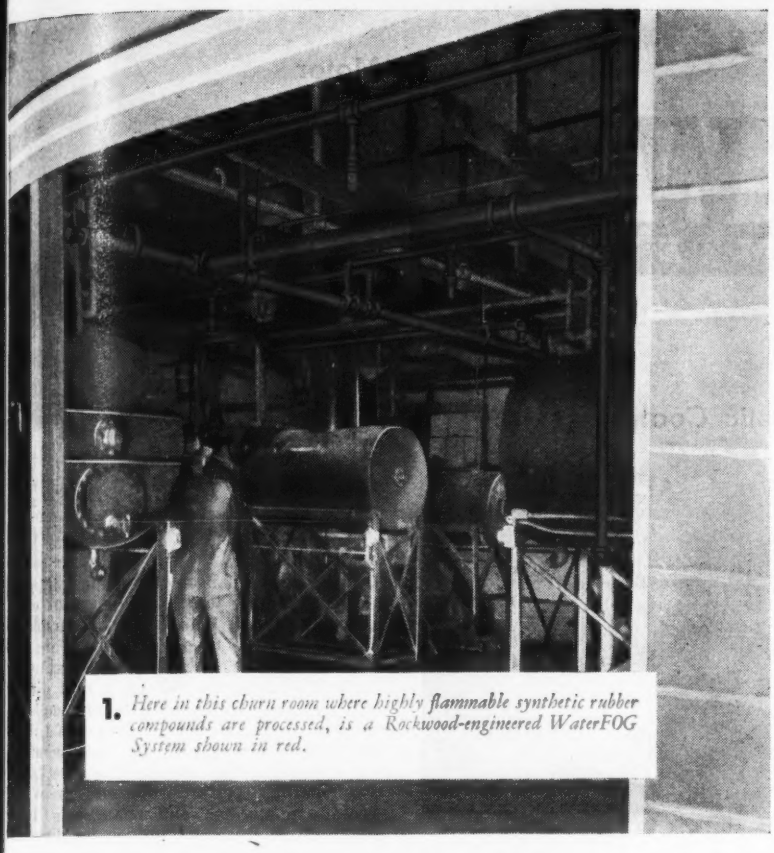
On Service

Company should have servicemen that all dealers could call on; small dealers can't afford a good serviceman	4
No free service	2
Conduct service school for dealers' repairmen	1
Assistance for service department regarding wiring, plumbing and location of water heater installations	1
Furnish entrance switch for new electric ranges	1
Company should pay all installation costs	1
Utility and dealers should work out a service policy	1
Repair service rates of utility too cheap	1

•

Kw.-Hr. Sales in Great Britain

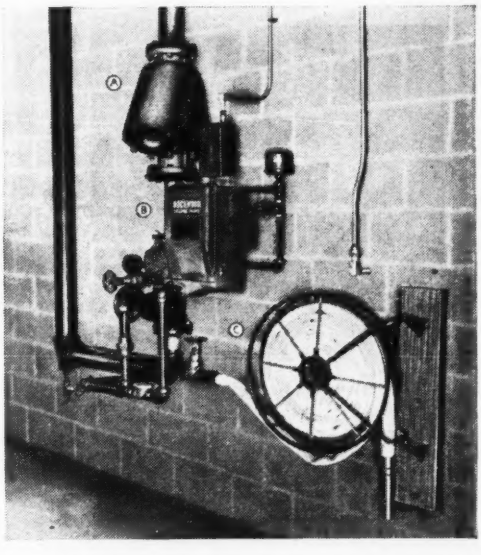
Latest annual statistics for 1943-'44 of energy sold and revenue therefrom in Great Britain, according to the *Electrical Review*, London, show rises in kw.-hr. sales of about 6 percent and in average revenue per kw.-hr. of some 0.3 percent over the previous year. Energy sold for lighting, heating and cooking, 9.7 billion kw.-hr., produced revenue of 66 million pounds, an average of 1.63 pence per unit. Power sales, 20.9 billion kw.-hr., produced 64.5 million pounds in revenue, an average of 0.74 pence per unit. Total sales, including public lighting and traction, were 31.83 billion kw.-hr. for a total revenue of 134.4 million pounds.



1. *Here in this churn room where highly flammable synthetic rubber compounds are processed, is a Rockwood-engineered WaterFOG System shown in red.*

2. *And this shows the Rockwood installation being tested. Notice how cooling, confining, smothering WaterFOG completely fills the room.*

3. *Here is the automatic control valve device which detects a fire and starts the fog. (A) Rockwood Strainwell Unit. (B) 2½ inch Rockwood Deluge Valve. (C) Auxiliary WaterFOG type N-22 nozzle, fire hose and hose reel.*



Why ROCKWOOD WaterFOG

SYSTEMS ARE SELECTED FOR CRITICAL WAR PLANTS

By impinging streams of water at a predetermined angle, Rockwood specially-designed equipment produces a most efficient WaterFOG pattern for fighting oil fires. Its myriad of tiny particles covers a broad area . . . ideal for places like the churn room above.

Every gallon of water changed to Rockwood WaterFOG absorbs about 8000 B.T.U's . . . remarkable cooling action for such a small amount of water. Then, as each gallon turns to steam, it occupies at least 230 cubic feet of space . . . choking off oxygen, snuffing out flames.

The most efficient installation of WaterFOG requires the specialized knowledge and background of Rockwood engineers. It is influenced by several important factors: the characteristics of the hazard itself, water supply, etc.

Rockwood-engineered systems in the form of fixed piping installations, approved by Underwriters' Laboratories and Associated Factory Mutuals. Nozzles and applicators for fire hose lines also available—used by Army, Navy, Coast Guard, U. S. Maritime Commission and hundreds of Industrial Plants. Write for Bulletin 123.

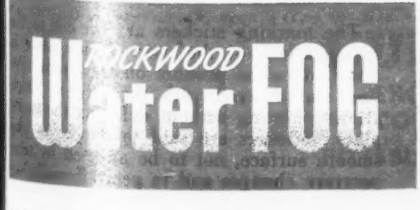
TYPICAL WaterFOG APPLICATIONS ARE:

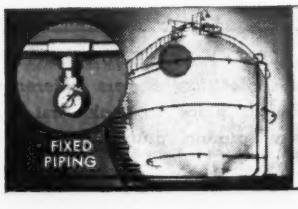
transformers	generators
oil switches	paint shops
control rooms	oil storage, etc.

ROCKWOOD SPRINKLER COMPANY
62 Harlow Street, Worcester 5, Mass.
Specialists in Fire Protection Engineering Equipment and Installation since 1907

Water Engineered by Rockwood Cools, Confines, Smothers Oil Fires

ARMY E NAVY





NEW EQUIPMENT

Fixture

"Cadet" model lighting fixture: 48, 60 and 96-in. lengths for 40, 100 and 40-watt F. lamps, respectively. **Edwin F. Guth Co.**, 2615 Washington Blvd., St. Louis, Mo.

"Cadet" model is an indirect type luminaire designed for schools, offices, drafting rooms, etc., and is suspended 24 to 30 in. beneath the ceiling in individual or end-to-end arrangement. Translucent cream-white deflectors are stated to deliver 90 percent of light upward and 10 percent downward. Fxture surfaces are reported as less than one candlepower per sq. in. and unit is said to "blend-in" with the lighted ceiling.

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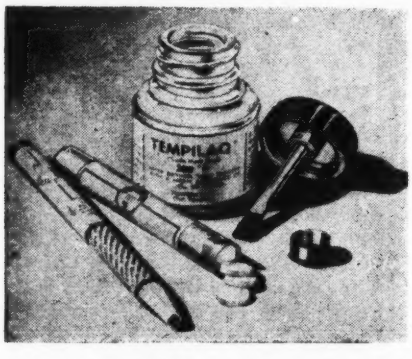
Temperature Indicators



Temperature indicators; stick, pellet and liquid forms; all three in 25 deg. intervals from 125 to 350 deg. F; stick range continues in 50 deg. intervals to 900 deg. F.; pellet and liquid forms continue in 50 deg. intervals to 1600 deg. F.; **Tempil Corp.**, 132 W. 22nd St., New York 11, N. Y.

Crayon-like stick, pellet and quick drying liquid which are reported to melt at a specified temperature. Applications include heat indications in welding, heat-treating and general fabrication of metals; measuring developed heat in motors, generators, etc.; and indicating temperatures on glazed or polished surfaces.

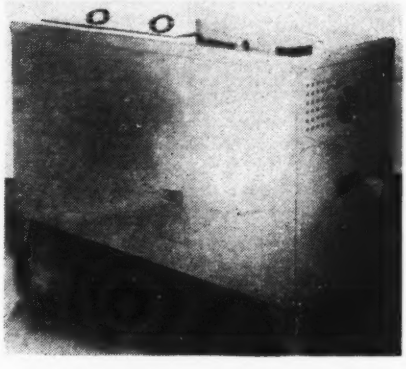
•

Infrared Equipment

Models 40-000 and 43-000 infra-red bank accommodate 125, 250 and 375 w., 120-v lamps; 6 tiers of 8 horizontal lamps; model 47-000 accommodates lamps from 125 to 1000 w.; **Fostoria Pressed Steel Corp.**, Fostoria, Ill.

Gold plated reflecting surfaces which are reported to increase efficiency 10 percent are used in all models. Protection for sockets and wiring channels is provided. All models are provided with castors. Angle separations may be inserted between sections to provide a variety of tunnel contours to conform to shape and size of material.

Plastic Coater



Model 3-8, capacity 3 to 5 lb. per hr. with dip compartment 6-in. wide, by 6-in. long by 9-in. deep; model 3-5, same with dip tank 13 in. deep; model 5-8, capacity 5 to 7 lb. per hr. with dip tank 9 by 12 and 6 in. deep; model 5-15 same with dip tank 13 in. deep; **Youngstown Miller Co.**, Sandusky, Ohio.

Each model is provided with a plastic pump which maintains a constant level in the dip tank and removes surface film. Oil jackets the bottom and side of the tank. Oil and plastic are thermostatically controlled.

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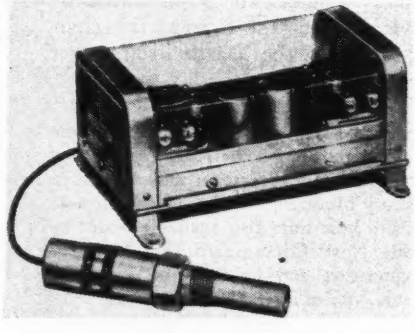
Temperature Regulator

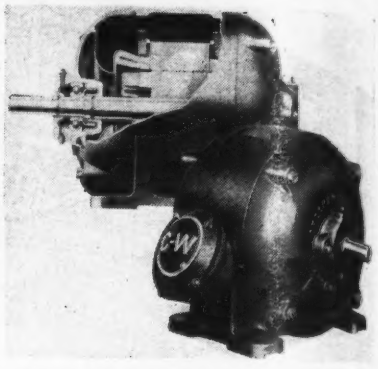


Temperature regulator; **Vapor Car Heating Co., Inc.**, Chicago 4, Ill.

Temperature regulating unit for heating and ventilating systems using motorized dampers for control. Has a gap between two contacts in a mercury thermostat. Contacts are set to meet temperature specifications and range of individual requirements.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Motor



Protected-type motor: rated 40 deg. C rise with 15 percent service factor; sizes up to and including 284 frame. **Crocker-Wheeler Division of Joshua Hendy Iron Works**, Ampere, N. J.

Motor which is protected against dripping liquids, falling metal chips and other foreign matter is said to be comparable in capacity to open types. Mountings are said to conform to NEMA standards. Centrifugal seals are said to permit use of softer grease. Rotor construction employed permits casting of bars, fans and end rings from aluminum alloys in one operation. Other features reported are heavy cast frame construction, coils protected by Vinyl Acetal insulation, interchangeable front and rear shields, and guides for directing cooling air over all surfaces.

•

Magnet

Sweeping magnet: portable; 18-in. working face. **Stearns Magnetic Mfg. Co.**, Milwaukee 4, Wis.

Unit consists of a drum with an 18-in. working face, permanently magnetized, mounted on a chassis for use inside or outside of factory areas, parking lots, etc., Accumulated scrap is picked up by the magnet and deposited in a tray behind the drum. Handle is provided for pushing and pulling the vehicle.

•

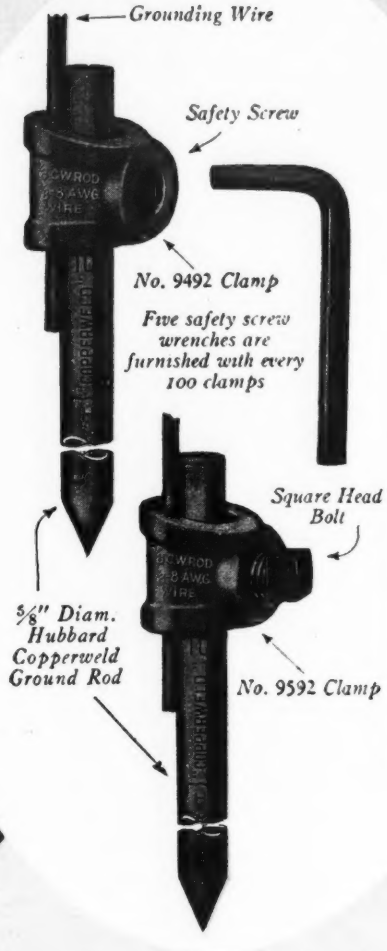
Stickers

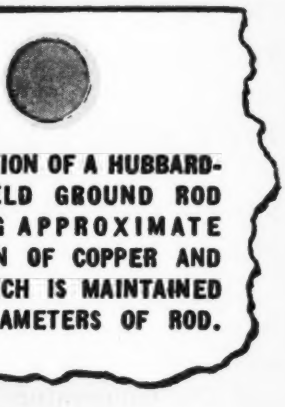
Name plate marking stickers die-cut; **Avery Adhesives**, 451 East Third St., Los Angles 13, Calif.

The marking stickers are die-cut to the specifications of the user. Name plate is attached to the product on the production line and covered with the sticker which allows painting without defacing the name plate. Stickers are said to adhere to any smooth surface, not to be affected by temperature changes and to peel off easily.

HUBBARD-COPPERWELD

GROUND RODS AND CLAMPS


Grounding Wire
Safety Screw
No. 9492 Clamp
Five safety screw wrenches are furnished with every 100 clamps
Square Head Bolt
5/8" Diam. Hubbard Copperweld Ground Rod
No. 9592 Clamp



CROSS-SECTION OF A HUBBARD-COPPERWELD GROUND ROD SHOWING APPROXIMATE PROPORTION OF COPPER AND STEEL WHICH IS MAINTAINED IN ALL DIAMETERS OF ROD.

RODS—DIAMETERS FROM 3/8" TO 1"—LENGTHS FROM 5 FT. TO 40 FT.

CLAMPS—TWO STYLES, SAFETY SET SCREW AND SQUARE HEAD BOLT—FOR ALL DIAMETERS OF RODS.

HUBBARD AND COMPANY

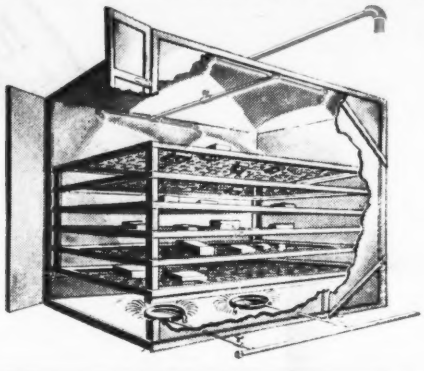
EXCLUSIVE NATIONAL SALES AGENT FOR
COPPERWELD GROUND RODS AND CLAMPS

PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Automatic" vs. Stubborn

FIRE-FOG DRYER FIRES

-a Fire Test of Interest to Every Manufacturer



Automatic FIRE-FOG ★ IT BLANKETS ★ IT ISOLATES ★ IT QUENCHES ★

The Time: Summer, 1944.

The Place: "Automatic's" Test Yard, at Youngstown, Ohio.

The Occasion: A test to determine the fire protection value provided by FIRE-FOG for a Dryer.

Frankly, FIRE-FOG was "on the spot"—other fire protection methods had failed.

Conditions at the manufacturer's plant were simulated. A test oven was built; drying racks were made; pieces of material distributed over the racks. Gas burners were lighted and the temperature brought up to the ignition point for the material tested and maintained for 15 minutes—*then* FIRE-FOG was introduced into the oven through FIRE-FOG Nozzles.

The result?—in only a matter of seconds the fire was extinguished! And only a few gallons of water had been used!

What has "Automatic" to offer you? "Automatic" service includes test, design, manufacture, and installation of the type of sprinkler system best adapted to extinguish YOUR fires. Write for complete information.

NOTE: In normal fire-fighting operations FIRE-FOG action is entirely automatic—it blankets . . . isolates . . . quenches -usually in a matter of seconds.

"Automatic" SPRINKLER CORPORATION OF AMERICA

YOUNGSTOWN, OHIO . . . OFFICES IN 31 CITIES

TECHNICAL LITERATURE

A.I.E.E. Report—Committee on Industrial Power Applications report in form of a book entitled "Electric Power Distribution for Industrial Plants." It is intended to promote the use of sound engineering principles in the design of electric power distribution systems for industrial plants and in the selection of equipment for these systems. The distribution system is considered as extending from the point of entrance of the power company service or plant generating bus to the terminals of the utilization devices. This includes high-tension sub-stations, distribution substations, feeders, circuits, switch centers and protective equipment. Copies, priced at $1.00 each, may be procured from American Institute of Electrical Engineers, 33 W. 39th St., New York City.

Arc Welding—Handbook of engineering data, "Arc Welding in the Maintenance and Construction of Tools and Dies", containing welding and heat treatment procedures for tool and die steels may be procured from C. E. Phillips & Co., 2750 Poplar Street, Detroit 8, Michigan. The data and curves demonstrate that the more that is known about the parent metal, the better the conditions are for satisfactory application of welding. Photomicrographs show grain structures in the arc welded and heated treated areas, and tempering curves indicate the hardness ranges obtainable by heat treatment.

Varnished Tubing—Proper selection of type and grade of flexible varnished tubing and sleeving for various insulating requirements has been simplified by the comprehensive set of standards which were adopted by and may be procured from the Varnish Tubing Association, Inc., 420 Lexington Avenue, New York, 17, N. Y. The standards cover tubing and sleeving made from cotton, rayon, nylon, and glass and also include the physical and electrical characteristics of the different grades.

Plastic Coating—A booklet describes properties and uses of plastic coating. Contains data relative to elimination of corrosion on equipment and structures. Range of application, coverage, colors, moisture absorption and transfer, etc., are presented. May be obtained from Amercoat Division, American Pipe and Construction Co., Box 3428, Terminal Annex, Los Angeles, 54, Calif.

Weather—Bulletin No. 120, Weather Headlines in Ohio, may be obtained from the Engineering Experiment Station, Ohio State University, Columbus, Ohio for seventy-five cents. Treated in the 124 pages are the cold and dry periods from 1780 to 1944 plus the data on heavy rains, floods and frost. Also included are data on hailstorms, icestorms, snow storms and wind storms.

Vibration—Publication (G E A-4140) describes vibration measuring instruments and their operation. Graphs, illustrations, and tables explain applications in improving quality of product, reduction of damage to machinery and buildings, and reduction of noise. Copies may be obtained from General Electric Co., Schenectady, N. Y.

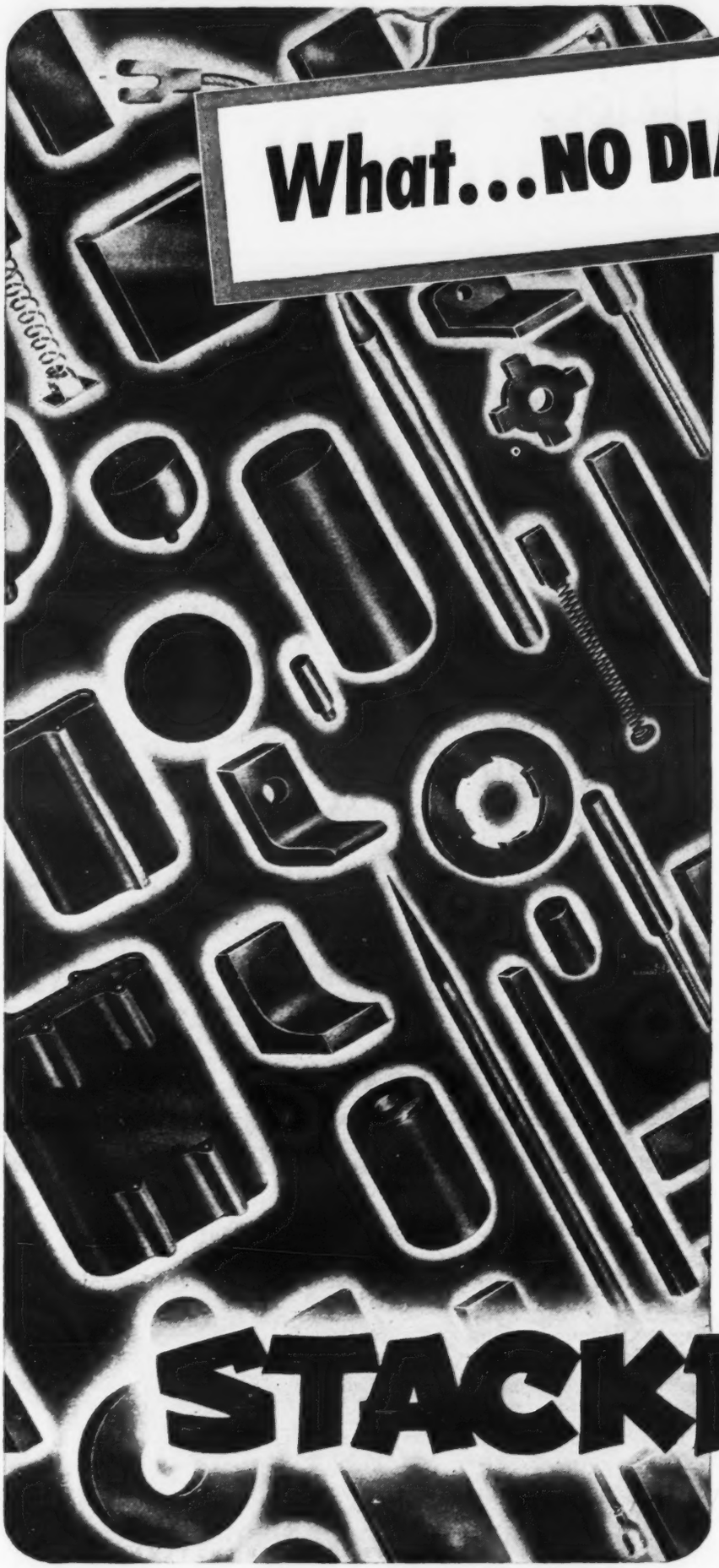
Graphical Symbols—Revised publication, "American Standard for Graphical Symbols for Telephone, Telegraph and Radio Use", includes new symbols for new types of apparatus and solutions for conflicting symbols in the power and communications fields. This Standard Z32.5-1944 may be obtained from the American Standards Association, 70 East 45th St. New York 17, N. Y., at 30 cents per copy.

Indian Tribes provided restive times for early settlers.

In Indiana, Fort Wayne resulted. One witness of the struggle was a lone Apple Tree overlooking the Fort. Around this tree clusters memories of stirring American days. *Etching by Edward C. Smith.*

Trees, whether historic or not, are valuable. They add to real estate and communities. Thus, when Utility Companies trim trees to clear power lines, it is important that the trees be trimmed correctly. The Asplundh Tree Expert Company has developed a technique of line clearing aimed directly at solving tree problems of Utilities. This technique includes everything from the approach to the job, to the final destruction of the brush. Utilities subscribe to our tree-trimming service.

ASPLUNDH TREE EXPERT COMPANY of JENKINTOWN, PENNSYLVANIA



What...NO DIAMONDS?

Yes . . . no diamonds—but you can rely on Stackpole for just about everything else you need in the way of molded carbons, as well as graphites, metals, and compositions. The following give some idea of the extent of the Stackpole line:

SMALL MOTOR BRUSHES
The nation's largest producer of brushes for fractional horsepower motors, generators, etc.

BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT
All carbon, graphite, metal and composition types—also rare metal contacts

PACKING, PISTON and SEAL RINGS
For all applications requiring an effective seal between a rotating and a stationary part

SPECTROGRAPHITE NO. 1
High-purity graphite for chemical and metallurgical analysis

POWDER METALLURGY COMPONENTS
Small sizes having special electrical characteristics

CONTINUOUSLY ADJUSTABLE CARBON RHEOSTAT DISCS
(Carbon piles)

BATTERY CARBONS

WELDING RODS, ELECTRODES, PLATES

BRAZING BLOCKS

POWER TUBE ANODES

CHEMICAL CARBONS

CARBON PIPE

CARBON SPECIALTIES, ETC., ETC.

•

Special Electronic Components

FIXED AND VARIABLE RESISTORS
Volume and tone controls, etc.

IRON CORES
Standard and high-frequency types—insulated types, side-molded types, etc.

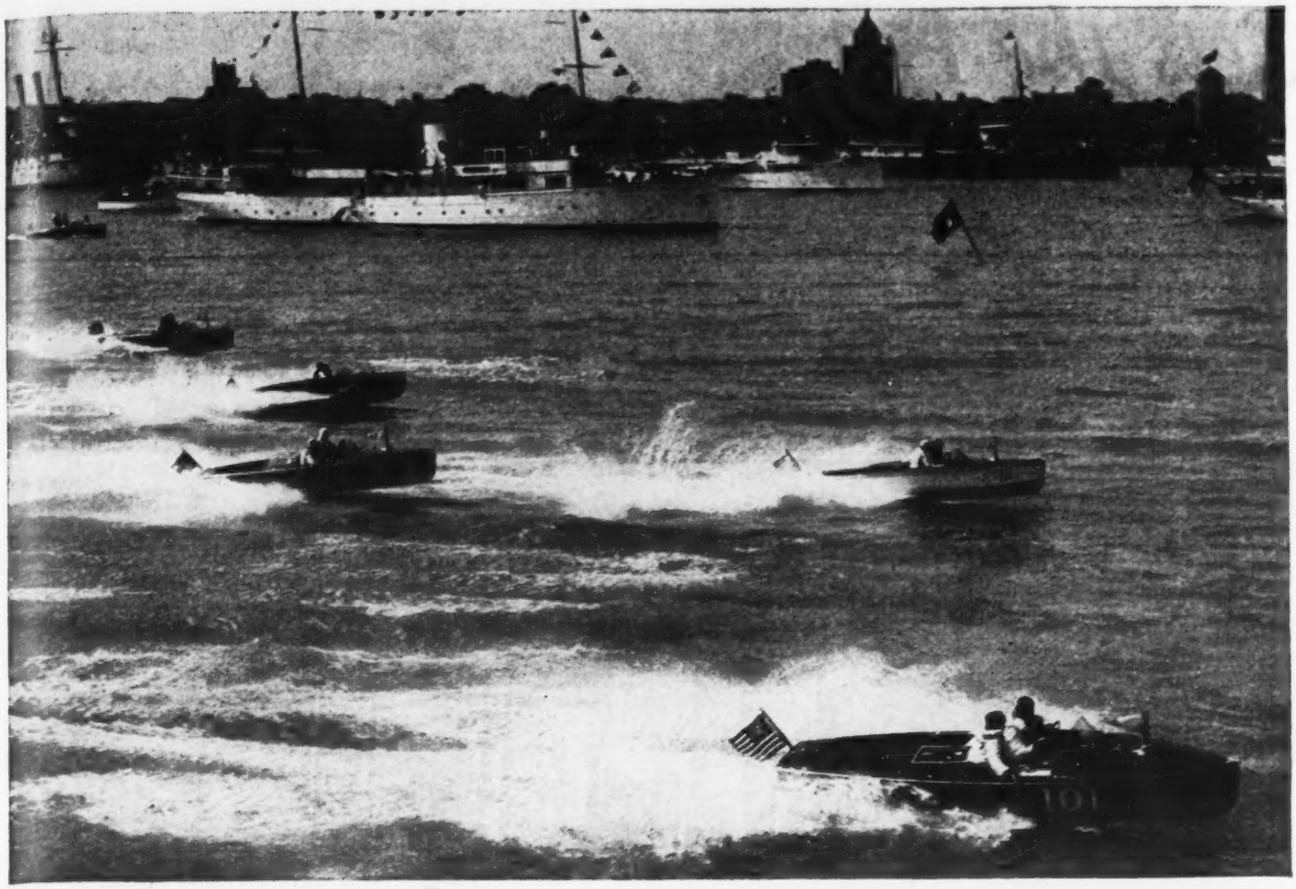
SWITCHES
Inexpensive line, slide, and rotary-action types.

WRITE for details on any product.

STACKPOLE

CARBON CO.

ST. MARYS, PA.



AWAY AHEAD!

Tobe Leads the Noise Elimination Field

WHAT are the real problems of radio noise interference? Can all man-made spark interference be eliminated? What is a sound source of information for the many problems concerning this entire subject?

The place to get these answers is at Tobe. For Tobe is the acknowledged leader in this field. For 17 years this organization has devoted its resources to the problems of noise elimination.

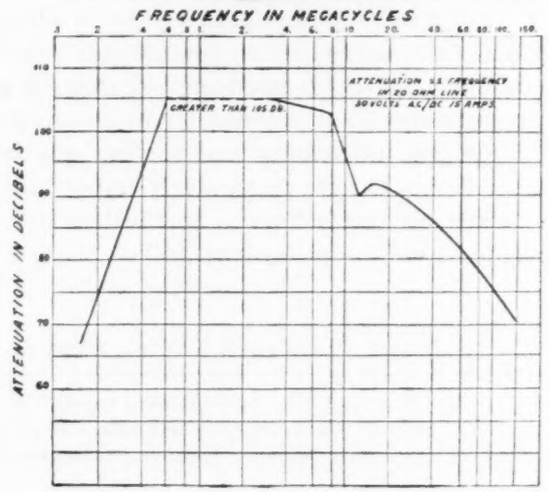
Tobe Filterizing is a copyrighted term describing the Tobe system of blotting-out unwanted "man-made" noise. Why not make use of our valuable experience? Write us about your problems.

TOBE DEUTSCHMANN CORP., CANTON, MASS.

SUPPRESS MAN-MADE RADIO STATIC
TOBE
FILTERIZED

CONTAINER DIMENSIONS

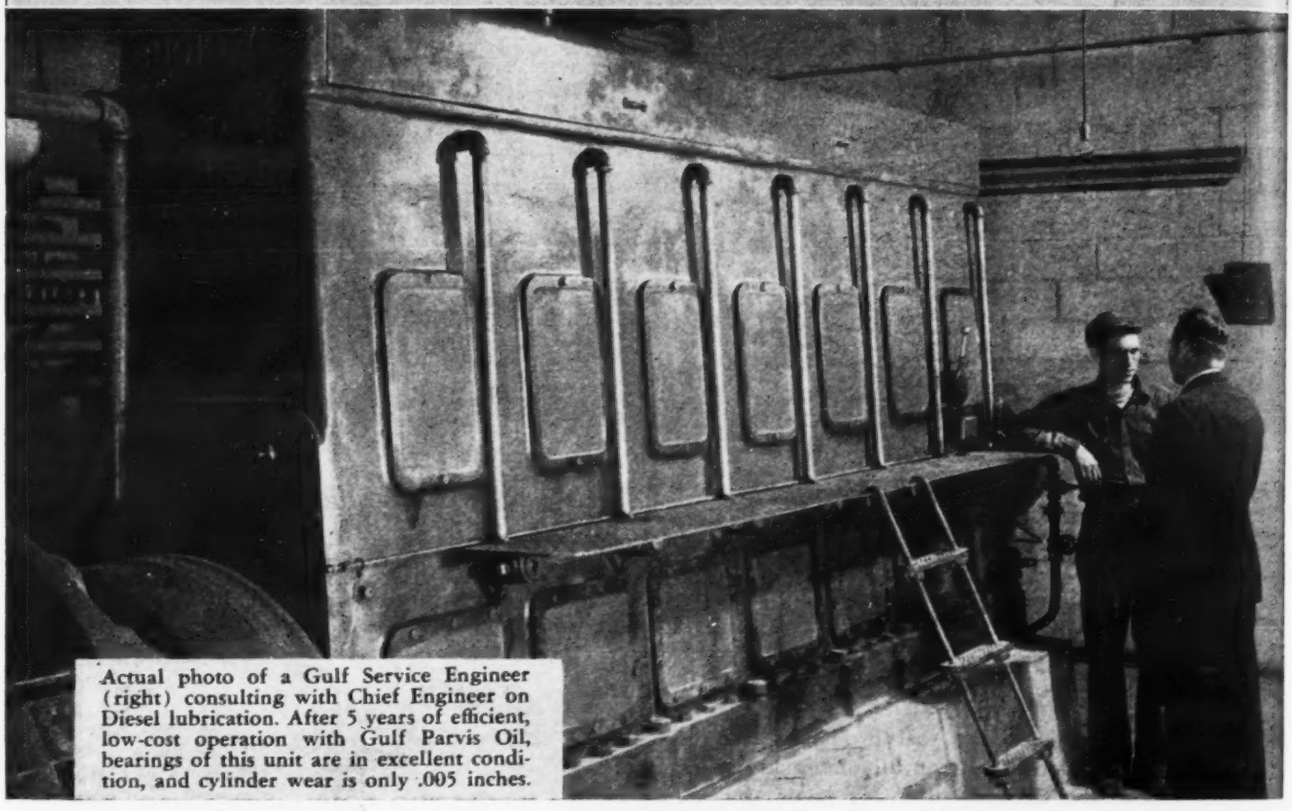
Length	3 1/16"
Width	2 1/8"
Height	2 7/8"
Overall length	5 7/32"


FREQUENCY IN MEGACYCLES
.1 .2 .4 .6 .8 1 2 4 6 8 10 20 40 60 80 100 150
ATTENUATION IN DECIBELS
110
100
90
80
70
60
GREATER THAN 105 DB
ATTENUATION VS FREQUENCY IN 20 OHM LINE 30 VOLTS AC/DC 15 AMPS

Sets the Pace

in the war on Diesel Maintenance Costs—

GULF PARVIS OIL



Actual photo of a Gulf Service Engineer (right) consulting with Chief Engineer on Diesel lubrication. After 5 years of efficient, low-cost operation with Gulf Parvis Oil, bearings of this unit are in excellent condition, and cylinder wear is only .005 inches.

FOR over 15 years Gulf Parvis Oil has been a leader in the fight against wear in Diesel engines. Ask users why they prefer Gulf Parvis Oil, and their answer is something like this: "It stands up and helps keep our maintenance costs down."

Superior lubricating and staying qualities of Gulf Parvis Oil are particularly important today —when outage is figured in the loss of vitally needed kw-hrs, as well as dollars. Gulf Parvis Oil is helping many Diesel operators get more efficient and more dependable performance from their units.

If you are not one of the hundreds of enthusiastic users of Gulf Parvis Oil, it will pay you to investigate—call in a Gulf Lubrication Service Engineer and ask him to recommend the proper grade to fit your particular requirements. Write, wire, or phone your nearest Gulf office today.

Gulf Oil Corporation · Gulf Refining Company

Division Sales Offices:
Boston · New York · Philadelphia · Pittsburgh · Atlanta
New Orleans · Houston · Louisville · Toledo

GULF INDUSTRIAL LUBRICATION

LIGHTING GLASSWARE BY CORNING WILL MEAN MORE THAN EVER . . . SOON!

It will be a great day when the production line is cleared of vital war jobs. Then, new and finer engineered lightingware by Corning will be available.

In the meantime, we are making every effort to serve the lighting industry to the best of our ability. We are trying to maintain in stock as many standard catalog items as possible to meet your requirements.

During the past four years the laboratory, engineering and production staffs of Corning have learned a great deal in solving problems important to the war effort. All this valuable information turned to the task of designing and producing lighting glassware is bound to produce outstanding results.

Definite plans are in progress for postwar *expansion* of our facilities for the production of new and more highly efficient illuminating glassware for tomorrow's better lighting.

The use of Corning engineered lightingware is gaining increased customer acceptance—and, Corning research and development will assure a continuation of our leadership in the field of illuminating glassware.

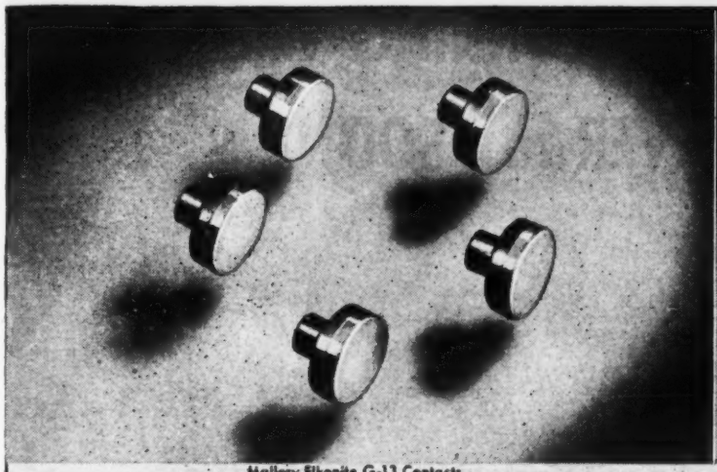
Send for your copy of "Corning Lighting Data," containing specifications and applications on the complete line of engineered Corning Flur-o-guide Lenses and Panels. Address Lighting Sales Dept., EW2 Corning Glass Works, Corning, N. Y.

"CORNING" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, New York.

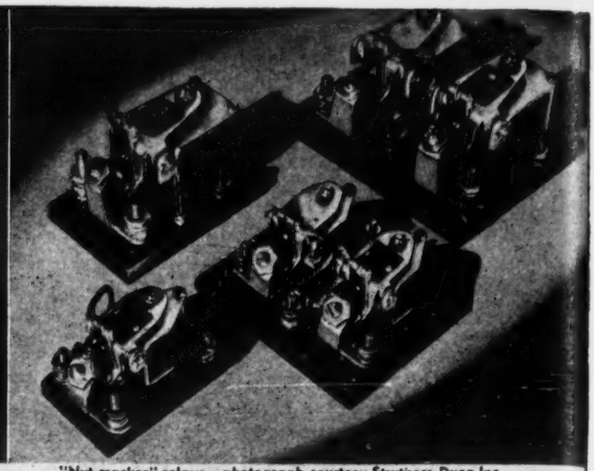
CORNING *means* Research in Glass

Corning Engineered Lightingware

BRAND



Mallory Elkonite G-13 Contacts.



"Nut cracker" relays—photograph courtesy Struthers-Dunn Inc.

Small...But They Carry High Inrush Loads...

MALLORY ELECTRICAL CONTACTS

ELECTRICAL contacts for these "nut cracker" relays must be *small*—space is at a premium. They must be *tough*—to stand shock and vibration. Contacts must be *electrically rugged*—to carry as much as 1000 amperes inrush current at 24 volts DC.

Mallory metallurgists and contact engineers have helped the relay manufacturer to find exactly the right contact material to meet these rigorous requirements. Elkonite* G-13, developed by Mallory, efficiently carries the high current load with no welding or arcing.

Its toughness meets physical "specs" not only for impact strength but also for wear resistance—assuring long life.

Elkonite compound metals may be the answer if you're seeking materials for contacts or contact assemblies with unusual electrical and physical properties. With Elkonite G-13 and the related G-12 and G-14 materials, there is a sufficient range of properties to cover applications from relatively low current switches and relays up to heavy-duty circuit breakers.

Consult experienced Mallory engineers on your contact and contact assembly problems. Often they can suggest complete assemblies that simplify your designs, save you fabricating time, and assure a more efficient product.

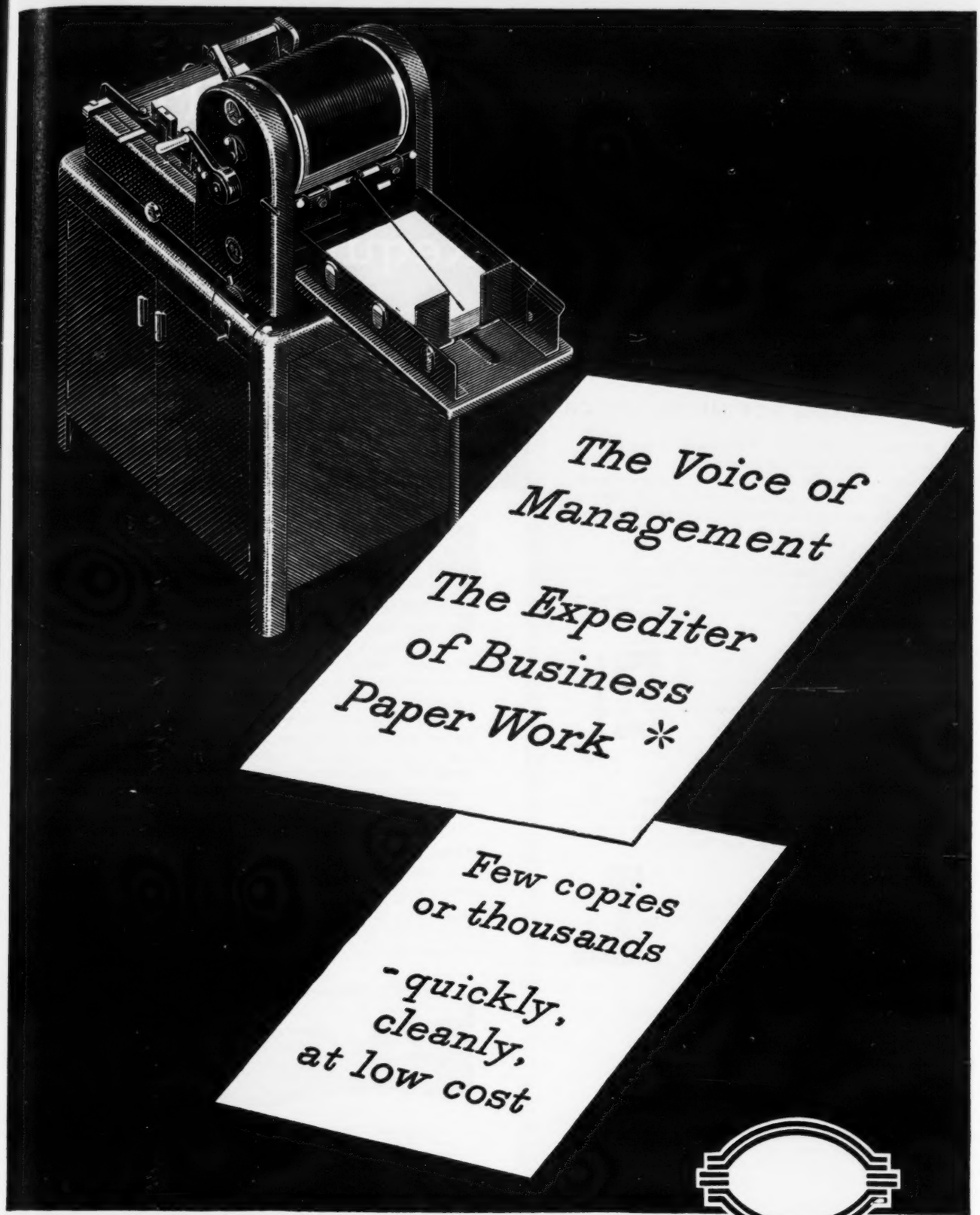
TYPICAL PHYSICAL PROPERTIES OF ELKONITE G-13

Grams per cc.	12.3
Lbs. per cu. in.	0.45
Conductivity %I.A.C.S.	55-60
Rockwell Hardness	70-80B
Tensile Strength psi	40,000
Cross Breaking Strength psi	115,000

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

**Elkonite: trademark registered by P. R. Mallory & Co., Inc., for electric contacting elements.*

ELECTRICAL CONTACTS AND CONTACT ASSEMBLIES



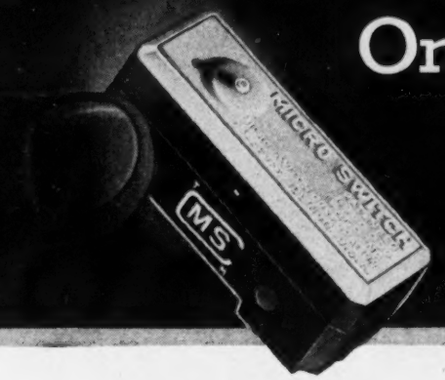
* The Mimeograph people offer you assistance in setting up systems based on their experience in a wide variety of business.

Mimeograph duplicator

COPYRIGHT 1945, A. B. DICK COMPANY

MIMEOGRAPH is the trade-mark of A. B. Dick Company, Chicago, registered in the U. S. Patent Office. A. B. DICK COMPANY, Chicago. The Mimeograph Company, Ltd., Toronto.

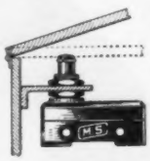
Only MICRO SWITCH Fills All These Requirements



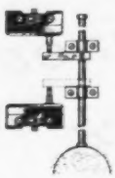
Thumb Size • Weighs Less Than One Ounce • Millions of Operations • Operating Force as Little as One Ounce • Operating Movement as Little as .0003" • Good Electrical Capacity • 1200 VA-AC

HUNDREDS OF UTILITY APPLICATIONS FOR MICRO SWITCH

Illustrated here are a few of the applications for which Micro Switch has proven accurate and dependable. Micro Switches are backed by a laboratory and engineering staff with years of experience in precision switching. We invite you to submit special switching problems to us.



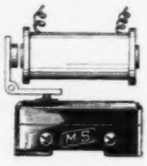
Cabinet Door Switch. For safety, alarm, or interlock on H.T. cabinets, transmitter or switch compartments. When the door is closed the Micro Switch is actuated, closing the circuit.



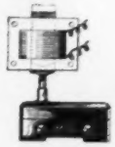
Level Gauge. Rod on float-actuated shaft carries arm which operates spring plunger switches at either "high" or "low" position. Signal would remain on until switches are manually reset.

Draft Indicator. A remote damper position indicator can be operated by a cam on a damper shaft and three switches to make contact at "open", "half" and "closed" positions.

Bellows Thermostat. Fluctuations in temperature change the length of the bellows to operate the Micro Switch.



Relay Control. Relay operates Micro Switch to control other circuits.



Solenoid Control. Solenoid, when pulled in, operates a spring plunger Micro Switch to control other circuits.

. . . . USES UNLIMITED

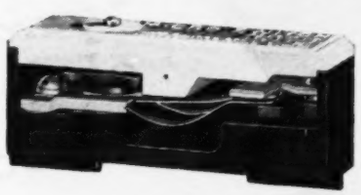
"Uses Unlimited"—a dramatic talking motion picture of Micro Switches, in color, is available to industrial groups, training classes, schools and colleges, through Y.M.C.A. Motion Picture Bureau, New York, Chicago, San Francisco. Size: 16 mm. Length: 40 minutes. Write us for details.

Utilities are rapidly finding more and more uses for the Micro Switch because this small, snap-action precision switch, more fully than any other, fills the needs for a switch to control substantial amounts of power and to operate in small space.

The basic Micro Switch in the Bakelite case is built with various contact separations and in several degrees of sensitivity, some switches requiring as little as 2/1000 ounce-inches of energy for operation. Basic switches are combined with a wide range of easy-to-use housings that provide conduit connections, mechanical protection, and several types of actuators. These housings also provide devices to absorb actuating motion beyond the small movement required to operate the Micro Switch. There are over 2700 variations of housings, actuators and electrical characteristics built around the basic Micro Switch.

Micro Switch is Underwriters' listed and rated at 1200 V.A. at 125 to 460 volts a.c. Capacity on d.c. loads depends on load characteristics.

Micro Switch Handbook-Catalog No. 60 will give you complete details as to electrical characteristics, construction, applications and dimensions. Send for it today.



Cut-away view of Micro Switch which shows clearly the three-bladed beryllium copper spring which is the patented heart of the Micro Switch.

A star has been added to our "E" flag as further recognition to the men and women of Micro Switch for maintaining our war production standards.

Let's All Back the Attack—Buy Extra War Bonds

© 1945

MICRO MS SWITCH
TRADE MARK

A DIVISION OF FIRST INDUSTRIAL CORPORATION

FREEPORT, ILL., U.S.A. Sales Offices in New York, Chicago, Cleveland, Los Angeles, Boston, Dallas, Portland, (Ore.)

Learn how versatile and economical your printmaking equipment is...

(Just make two comparisons)

1. Compare your versatility when ordering prints with that of the OZALID user.

With Ozalid, you specify any one of a variety of types:

OZALID Work Prints
- **Black-line**
- **Blue-line**
- **Red-line**
- **Black-line opaque cloth**

Only Ozalid gives you a print for every purpose, allowing you to do such efficient things as to assign identifying colors (black, red, blue) to prints of different departments, to distinguish checked from unchecked prints, etc.

OZALID Intermediates
- **Black-line**
- **Sepia-line**
- **Foils**
- **Tracing Cloth**

Only Ozalid gives you a full line of intermediates which may be (A) substituted for valuable original tracings in subsequent print production (B) readily altered when design changes are necessary (C) employed to make composite prints or to reclaim soiled originals.

In addition, Ozalid gives you DRYPHOTO—the new paper which produces beautiful reproductions, complete with half-tone detail, from film-positives of any photographic subject or perspective drawing.

2. Compare the methods you now employ to make prints . . . with OZALID "Simplified Printmaking."

With an Ozalid machine you produce all prints in the same manner. Only two steps—Exposure and Dry Development . . . and in seconds your prints are delivered dry, ready for immediate use. No "leaders" are used . . . and you can process cut sheets as well as roll stock, eliminating trimming waste.

Some more Ozalid features you'll appreciate

Anyone can be trained quickly to operate an Ozalid machine at top efficiency...operating and maintenance costs are low...design is so compact that for convenience sake, you may want to install your Ozalid machine in a corner of the drafting room or office.

Write for "Simplified Printmaking" today

It explains OZALID in detail; contains samples of prints; shows how inexpensive it is to adopt; and how you can use it in all departments.

ARMY E NAVY

OZALID

DIVISION OF GENERAL ANILINE AND FILM CORPORATION • JOHNSON CITY, N. Y.

OZALID IN CANADA—HUGHES-OWENS CO., LTD., MONTREAL

NEWS ABOUT PEOPLE

California Edison Co. Elects New Officers

Announcement of the election by the board of directors of the Southern California Edison Co. of additional officers for the company, all from the present management organization, was recently made by Harry J. Bauer, president.

E. R. Davis, assistant general manager since 1932, was elected vice-president and assistant general manager. Mr. Davis is one of the foremost construction engineers in the electric utility industry and was one of the chief engineers of the Edison Big Creek-San Joaquin hydro electric development. His activity in the electrical industry of southern California dates from 1896 and he has been identified prominently with the advancement of technical phases of electrical engineering and operation.

N. B. Hinson, who also has been closely identified with the operating and engineering of the company for many years, was elected vice-president and executive engineer. Mr. Hinson is chairman of the Pacific Southwest Power Interchange Committee, which is one of the most important factors in the direction of generation and utilization of electric power for war industry in this area. He has held a number of executive engineering positions in the company with which he first became identified in 1906. He was appointed chief engineer and chairman of the company's engineering committee in 1934.

Ralph R. Walbridge, commercial manager of the company since 1939, was elected vice-president and will have charge of business development activities of the company. He has had wide experience in Edison commercial affairs both in the company's district organization and as a management officer.

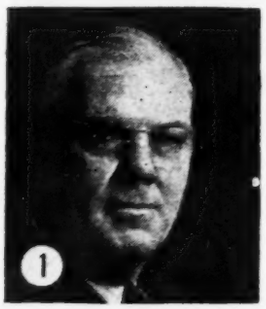
R. C. McFadden, sales manager since 1939, has been appointed assistant vice-president to assist in the administration of commercial and new business activities of the company. Mr. McFadden has been associated with the company since 1916.

H. W. Tice was elected vice-president and will continue as manager of operation, the position he has held since 1941. Mr. Tice who, before his affiliation with the Edison company in 1922, was identified with the electrical manufacturing and steel manufacturing industries, became operating engineer for the company in 1927 and assistant manager of operation in 1937.

R. G. Kenyon, assistant vice-president since 1942 and formerly advertising manager, has been elected vice-president and will continue in charge of industrial relations for the company, the activity in which he has been engaged. Mr. Kenyon first was employed by the Edison company in 1917 and became advertising manager in 1932 after serving in the accounting, securities and employment departments.

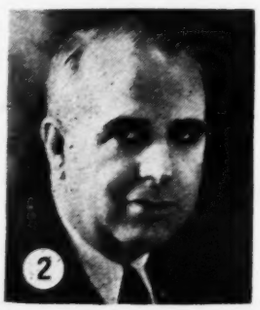
Gail C. Larkin, a member of the Edison organization since 1922 and general counsel since 1942, was elected vice-president and general counsel. He will continue as directing head of the company's law department.

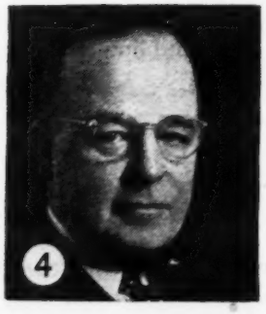
O. V. Showers, assistant secretary of the company since 1917 and a member of the company's investment department, was elected secretary to succeed the late Clifton Peters.



1. N. B. Hinson
2. R. R. Walbridge
3. H. W. Tice
4. R. G. Kenyon
5. G. C. Larkin

Glaeser Studio





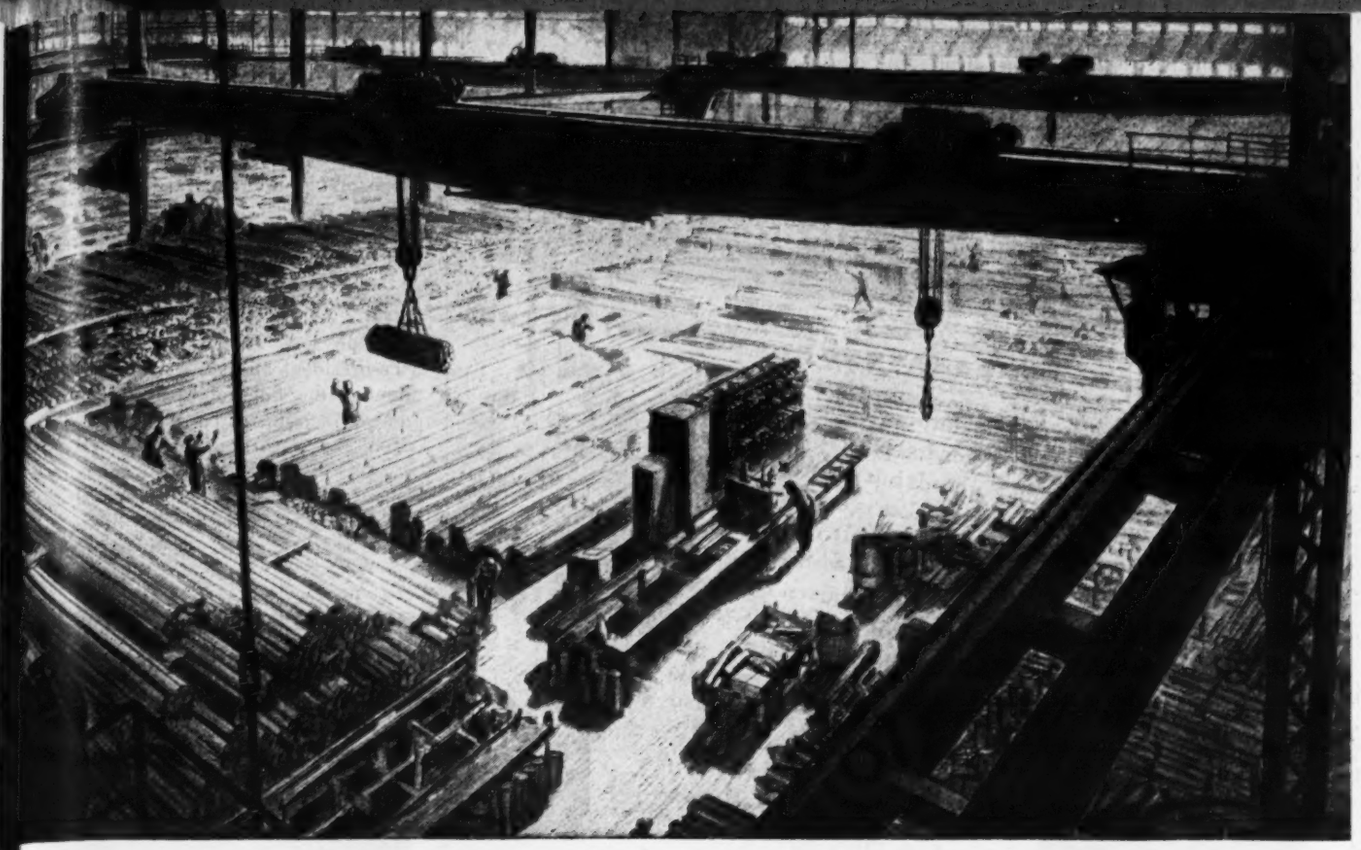
Florida Power Elects Bailey Vice-President

J. F. Bailey, president of the Georgia Power & Light Co., has been named a vice-president and director of the Florida Power Corp. Mr. Bailey will retain the presidency of the Georgia property, but will make his headquarters in the Florida Power offices in St. Petersburg. The Georgia property has long been an affiliate company of Florida Power Corp. but now is wholly owned by Florida Power.

A veteran of thirty years in the utility business, Mr. Bailey has been president of the Georgia property for the past seven years.

•

▶ K. B. AYRES, superintendent of electric transmission and distribution for the San Diego Gas & Electric Co., has retired after completing 34 years of service. Starting in 1911, Mr. Ayres helped install the company's first underground electric distribution system in San Diego. As a superintendent of construction for San Diego's northern districts, he pioneered the surveys and original construction for electric systems in Escondido, San Marcos, Vista, and Rincon, as well as providing tie-ins between these areas and Oceanside. Promoted to superintendent over the company's entire electric distribution and transmission system in 1918, he managed the building of a greater part of San Diego's present system. Dur-



STEEL—In Ryerson Stock

for Immediate Shipment

When you need steel quickly get in touch with your nearby Ryerson plant. Every kind of steel is in stock—more than 10,000 shapes, sizes and analyses. And Ryerson deliveries set a standard for quick dependable service.

The eleven-plant Ryerson network is staffed with engineers, metallurgists—experts on problems of steel supply, application and fabrication. You'll get prompt, personal attention when you call Ryerson.

Write for a Ryerson Stock List, your guide to immediate steel.

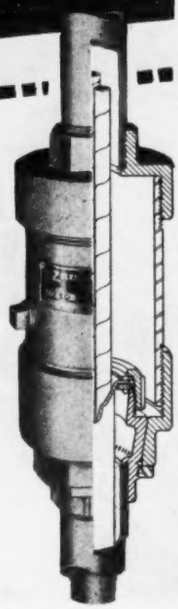
Partial List of Products

Bars	Shafting	Reinforcing Steel	Tool Steel
Shapes	Strip Steel	Safety Floor Plate	Babbitt Metal
Structurals	Mechanical Tubing	Alloy Steel	Solder
Plates, Sheets	Boiler Tubes and Fittings	Allegheny Stainless	Welding Rod, Etc.

Joseph T. Ryerson & Son, Inc., Steel-Service plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Pittsburgh, Philadelphia, Jersey City

RYERSON STEEL-SERVICE

GET MULTI-PURPOSE SERVICE with O. Z. "J" Terminator Potheads

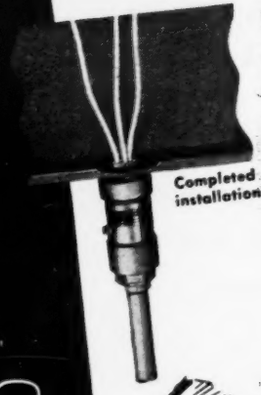


This "J" Terminator, developed by O. Z. incorporates the general principles of O. Z. Terminating Potheads but adds a collapsible feature which makes it easy to install The collapsible feature also provides a method of tying in conduit with a pothead to the under side of pull boxes, cabinets and transformer secondary boxes. The access chamber provides ample space for pulling in of wire and splicing if desired. This chamber also affords working space for bell-ing and sealing cables on the O. Z. adaptor especially designed for this purpose.

Disassembled on conduit

THE O. Z. "J" TERMINATOR is also adaptable for straight through conduit runs.

When installing with cabinets—the conduit work is terminated at the proper height below the box. The "J" terminator is dismantled and properly assembled on the end of the conduit, then tied into the box with a chase nipple furnished with the fitting. When wiring work is underway, the unit can be disassembled again on the conduit, permitting sealing of wires, then reassembled complete, making a mechanical bond between the conduit raceway system and the box.



Completed installation

ONE CATALOG—ONE SOURCE

Many additional new types of electrical fittings are illustrated in the 144 page O. Z. Catalog. In this handy buying guide you can quickly find complete information about Conduit Fittings . . . Cable Terminators . . . Junction Boxes . . . Solderless Connectors . . . Power Connectors . . . Grounding Fittings. A free copy will be sent on request.

7769

O. Z. ELECTRICAL MFG. CO.

262 BOND STREET · BROOKLYN, 2 N. Y.

REPRESENTATIVES IN PRINCIPAL CITIES

ing his 21 years of active membership in the Pacific Coast Electrical Association he held chairmanships on many important committees.

•

R. J. Cordiner Elected to G.E. Vice-Presidency

Ralph J. Cordiner has been elected vice-president and assistant to the president of the General Electric Co., with general administrative duties as designated by the president, Charles E. Wilson, president, recently announced. Since his resignation as vice-chairman of the War Production Board 18 months ago, he has been assistant to the president.

A former manager of the G-E appliance and merchandise department,

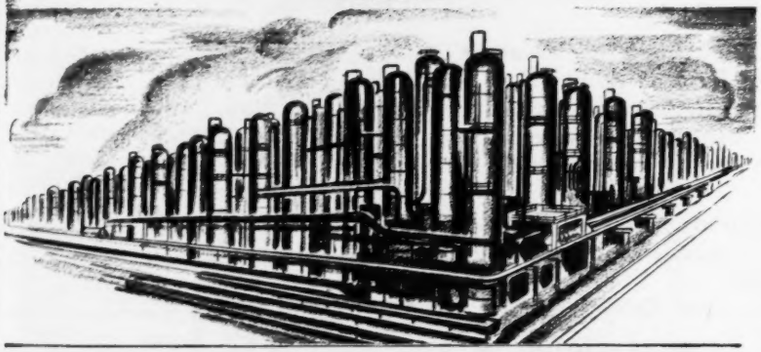
Mr. Cordiner has been continuously connected with the electrical industry since his undergraduate days at Whitman College in Walla Walla, Wash., when he was employed part-time as an electrical appliance salesman by the Pacific Power & Light Co. Subsequently he joined Edison General Electric Appliance Co. and when the heating device activities of that organization were consolidated with General Electric's merchandise department at Bridgeport, Mr. Cordiner also moved, as manager. In the course of a few years he was appointed manager of the appliance and merchandise department of General Electric but in 1939 he resigned to become president of Schick Inc., of Stamford, Conn. He left Schick in 1942 to enter government service as director general of war production scheduling and vice-chairman of WPB.

•

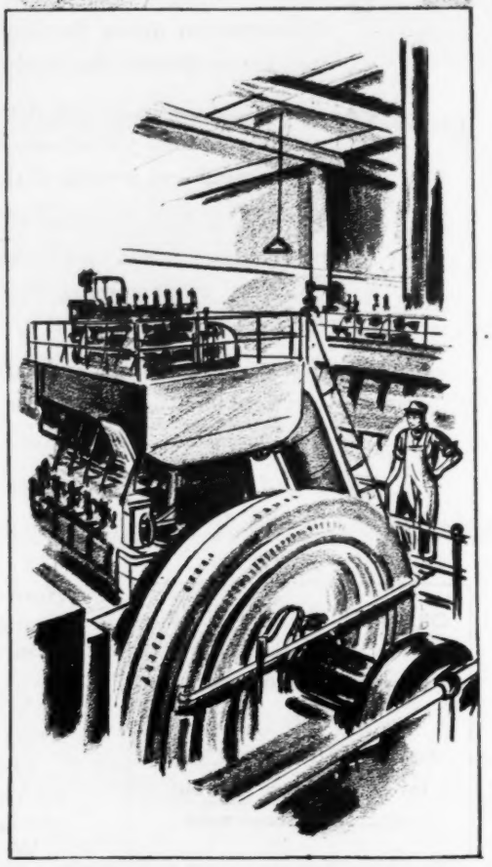
▶ HERBERT BRIGGS, JR. has been appointed advertising manager of the Philadelphia Co. group of public utilities of Pittsburgh, Pa., which includes the Duquesne Light Co. Mr. Briggs entered the service of the Duquesne Light Co. in 1921 as a test engineer,

Do you know that . . .

SINCLAIR PRODUCING OIL WELLS IF PLACED END UNDER END WOULD REACH TO THE CENTER OF THE EARTH—MORE THAN 3,500 MILES. SINCLAIR RANKS AMONG THE LARGEST PRODUCERS OF CRUDE OIL.



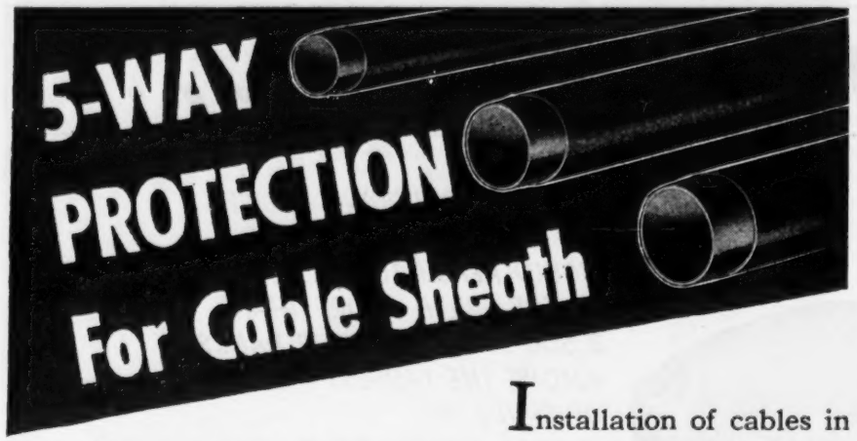
SINCLAIR'S 10 GREAT REFINERIES, IF MASSED TOGETHER, WOULD COVER AN AREA OF 2,300 ACRES —THE APPROXIMATE AREA OF A CITY OF 100,000 POPULATION. THESE REFINERIES MANUFACTURE A FULL LINE OF QUALITY PETROLEUM PRODUCTS FOR ALL MILITARY, INDUSTRIAL AND GENERAL USES.



A CLEANER DIESEL ENGINE IS MADE POSSIBLE BY THE DETERGENT CHARACTERISTICS OF SINCLAIR TEN-OL 200. THIS IS ONE OF SEVERAL SINCLAIR OILS PREPARED SPECIFICALLY FOR BETTER DIESEL LUBRICATION.

SINCLAIR IS EQUIPPED TO SERVE YOU BETTER!

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.



Installation of cables in ORANGEBURG ducts assures longer cable life and reduces cable failures by protecting sheath these 5 ways:

1. *Low Pulling Tensions* — When cables are pulled into ORANGEBURG ducts, the low coefficient of friction keeps tension low in sheath and conductor, making longer pulls possible.
2. *Minimum Cable Sheath Abrasion*—Installed cables creep and move with load variations. In ORANGEBURG ducts the danger of abrasion and scoring of the sheath is kept to a minimum.
3. *Protection From Ground Water Infiltration*—With their tight taper sleeve joints and impermeable wall, ORANGEBURG ducts go far to prevent entry of corrosive ground waters along the duct system.
4. *Non-Corrosive* — ORANGEBURG ducts are composed of materials which will not injure cable sheath. On aging, they do not produce reactions which might cause sheath corrosion.
5. *Non-Corrodible*—ORANGEBURG ducts are themselves resistant to the destructive action of ground waters and industrial wastes.

ORANGEBURG STANDARD
for installation *with* concrete encasement

•

ORANGEBURG NOCRETE
for installation *without* concrete encasement

Here Are Other Important Features of Orangeburg Fibre Conduit: Ease and economy of installation with versatility of layout. Standard service fittings which avert costly delays in field construction.

ORANGEBURG'S "know how" is backed by 50 years' experience in the electrical conduit field.

Write for new Catalog No. 49.

THE FIBRE CONDUIT COMPANY • ORANGEBURG, N. Y.
GENERAL ELECTRIC SUPPLY CORP. *Distributors* GRAYBAR ELECTRIC CO., INC.

ORANGEBURG FIBRE CONDUIT

THE FIBRE CONDUIT CO. ORANGEBURG N.Y.

ORANGEBURG

WITH 50 YEARS EXPERIENCE IN THE MANUFACTURE OF NON-METALLIC CONDUIT AND PIPE, SERVES THE POWER AND LIGHT, TELEPHONE, GENERAL CONSTRUCTION, CHEMICAL, PETROLEUM, PLUMBING AND BUILDING SUPPLY FIELDS WITH ELECTRICAL FIBRE CONDUIT . . . ELECTRICAL UNDERFLOOR DUCT SYSTEMS . . . AND FIBRE PIPE FOR NON-PRESSURE USES.

power stations department. He transferred to the advertising department in 1925 and later became assistant advertising manager, the position he held at the time of his promotion.

•

W. O. Lippman Assumes New Executive Duties

Appointment of W. O. Lippman as assistant to the president of the Westinghouse Electric & Manufacturing Co. in charge of the headquarters manufacturing department was recently announced. He will continue as manager

of the U. S. Naval Ordnance Plant at Canton, Ohio, which is operated by Westinghouse. Mr. Lippman, whose headquarters will be in Pittsburgh, succeeds Ellis L. Spray, who was recently elected vice-president and general manager of the Westinghouse Electric Elevator Co. in Jersey City, N. J.

At the same time J. R. Weaver, manager of the U. S. Naval Ordnance Plant operated by the company at Center Line, Mich., was named works manager of the East Springfield, Mass. Works of the company's electric appliance division, succeeding Mr. Lippman. Mr. Weaver will continue to head the Michigan plant.

Mr. Lippman joined Westinghouse at the East Pittsburgh Works in 1918 and five years later transferred to the East Springfield Works, in 1939 becoming works manager there. This position he held until he was named manager of the Canton Ordnance Plant in early 1943. He was recently reappointed to the managerial position in the Massachusetts Works.

•

▶ DR. E. F. W. ALEXANDERSON, consulting engineer and radio expert of the General Electric Co., received the Cedargren gold medal from the Royal Institute of Technology of Sweden at a ceremony held in the Stockholm restaurant in New York on Friday, February 9. This medal, awarded but

"BODY-WISE"

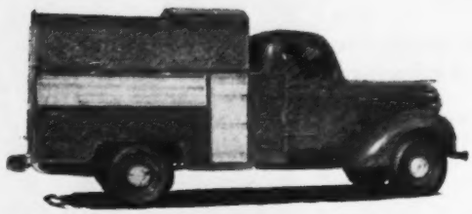
they prefer

YORK-HOOVER

ALL-METAL BODIES

Electric power and light companies prefer York-Hoover All-Metal Bodies because they're designed for the job, and built to "take it"—as evidenced by those now in every day operation—way beyond the normal depreciation period.

Be "Body-Wise"! Consult York-Hoover

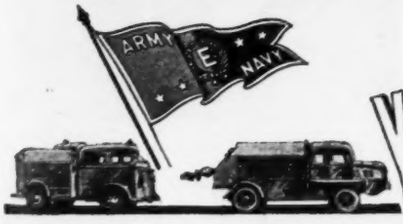


York-Hoover Model 2050 Light Service Body for ½ ton commercial chassis. Note: Three pull out drawers with adjustable partitions, also additional material drawers with three sliding apparatus trays in front compartment.

Model HCW-115 is a Medium Duty Line Construction Body incorporating side material and tool cabinets, telescoping roof and ample water tight compartment for rubber goods. Specific requirements for side cabinet interior layout can be obtained.

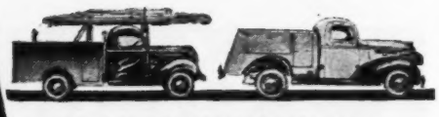
York-Hoover Model 4013-AL, combination service and cable body unit incorporating capstan or horizontal winch, overhead ladder and ring assembly, ample space for tools and materials in side cabinets, telescoping roof and diamondette steel floor.

Model 4013 Open Type Service and Meter Body—75" long installed on ½ ton chassis; also furnished 90" long for ¾ ton chassis. Can be obtained with top enclosure having stationary or telescoping roof with overhead or side mounted ladder brackets.

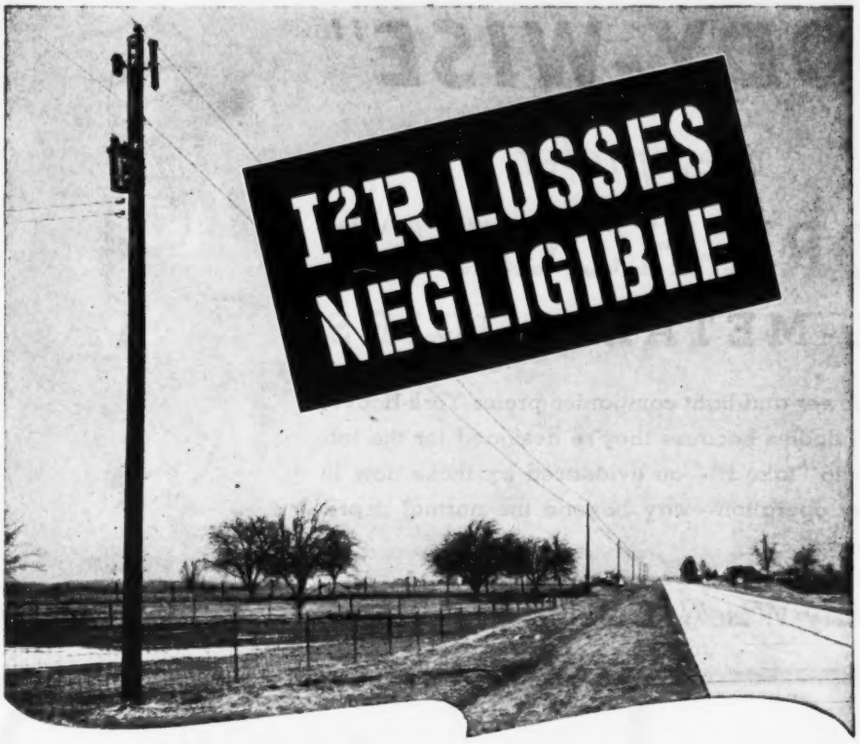


BODY DIVISION

YORK-HOOVER CORPORATION



YORK, PENNSYLVANIA



Line losses on rural lines built of *Crapo* Steel Conductors are negligible compared with the overall savings made possible by these conductors.

For example: let's assume we are to build a single-phase, 6900-volt line 5 miles long with a normal load of one kilowatt per mile and 0.90 power factor. Assuming that the load is concentrated at far end of the line, the 5-kilowatt load will have a current of 0.81 amperes. The total resistance of this line built of No. 6 B.W.G. *Crapo* HTC-130 Stranded (3-wire) Steel Conductor will be 5 (miles) x 2 (conductors) x 11.29 (ohms per mile) or 112.9 ohms. The square of 0.81 amperes is 0.656 which, multiplied by 112.9 ohms, equals 74 watts.

For uniformly distributed loads the line loss is approximately two-thirds of that for concentrated loads. The I^2R loss for the line described above will be two-thirds of 74 watts or 49 watts. This means that the I^2R loss in delivering five kilowatts is only 1% of the input energy.

Actual operating experience of all REA Co-operatives for 1942 shows that the average load per mile of line was approximately one-third of a kilowatt. With a load of one-third kilowatt per mile, the I^2R loss on the 5-mile line will be only 5.4 watts. The total I^2R loss for a 24-hour day will be 0.13 kilowatts. Even at one cent a kilowatt-hour, this would mean but 0.13 of a cent per 24-hour day; approximately 47 cents per year for the 5 circuit miles, or 9.4 cents per mile per year.

Such a loss is insignificant compared with the savings of $100 to $150 per mile which have been reported where *Crapo* Steel Conductors have been used in long-span rural-line construction.

Your Post-War Plans

Consider the economical advantages of *Crapo* Steel Conductors in developing your post-war plans for extending rural lines! Complete technical information, including electrical and physical characteristics, sag and tension data, recommended construction practices, etc., will be found in our Engineering Manual, available upon request.

Crapo Steel Conductors are distributed by Graybar Electric Company, Inc. Ask the Graybar representative or write direct for your copy of the Manual.

INDIANA STEEL & WIRE COMPANY
MUNCIE, INDIANA

Crapo HTC-130 STEEL CONDUCTORS

once every five years, was instituted by the will of the late Henrik Tore Cedergren, telephone pioneer of Sweden, in 1909. Dr. Alexanderson has just received the Edison medal of the American Institute of Electrical Engineers. Presentation of the Cedergren medal was made by Martin Kastengren, Swedish Consul General.

•

Executive Changes Made by New York Utility

Changes in the executive personnel of New York State Electric & Gas Corp., Ithaca, have been announced.

William G. Hickling, vice-president in charge of operations, assumed addi-

W. G. Hickling

tional duties as general manager and A. W. Milliken, vice-president and manager of the company's eastern division, was made superintendent of operations. Under the change, Mr. Hickling con-

Blank & Stoller

A. W. Milliken

tinues as head of operating matters on a state-wide basis and in addition, the company's five division managers and the heads of safety and personnel report to him.

Mr. Hickling joined New York State

EXIDE BATTERIES
On duty with the Stations
that spin the wheels of war industry
America's Light and Power Companies have produced many extra billions of kilowatt hours to keep the wheels of industry turning, and war-goods production at its peak. Exide is proud of being permitted to serve so large a percentage of these great Stations, and for so many decades.
Exide makes several types of storage batteries for control bus operation. These batteries have earned the confidence of engineers everywhere, and their widespread use in public utilities and private industrial plants is proof of their dependability, long-life and ease of maintenance. When you buy an Exide, you *Buy* to *Last.*
Whatever your battery problems, Exide engineers will be glad to help you solve them.
ARMY E NAVY
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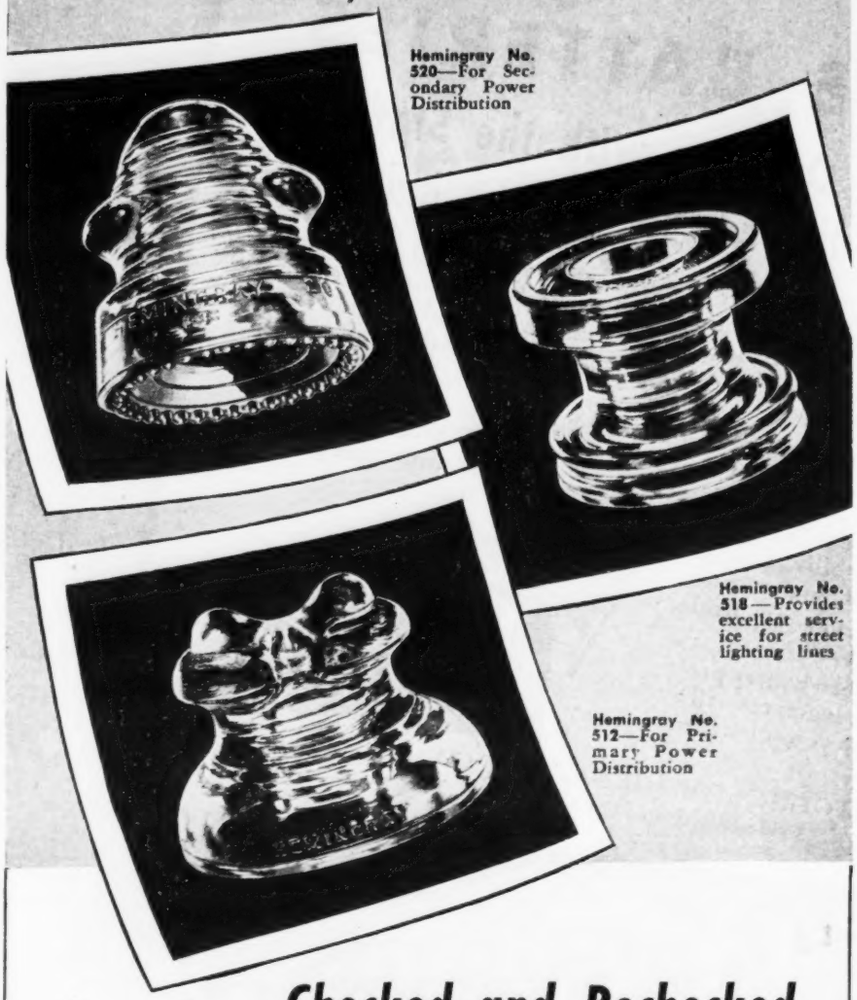
BATTERIES
THE ELECTRIC STORAGE BATTERY CO., Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

HEMINGRAY INSULATORS

Favorably Known Since 1870



Hemingray No. 520—For Secondary Power Distribution

Hemingray No. 518—Provides excellent service for street lighting lines

Hemingray No. 512—For Primary Power Distribution

Checked and Rechecked

. . . All Along the Line!

Hemingray Insulators are made under careful supervision—under exacting step-by-step quality production control. That's why they're so *tough* and *strong*—so *dependable*.

Try them! The cost is low to begin with—lower in service-life.

There are ten Hemingrays for Primary Power distribution for voltages from 2,300 to 15,000 and manufactured in accordance with suggested specifications of the Edison Electric Institute.

There are ten Hemingrays for Secondary Power distribution with Heights ranging from $2\frac{15}{16}$ to $5\frac{1}{32}$ inches and Diameters ranging from $2\frac{1}{4}$ to $3\frac{1}{4}$ inches.

Investigate! Hemingrays are sold by principal jobbers and are manufactured by Owens-Illinois, Hemingray Division, Muncie, Ind.

OWENS-ILLINOIS

HEMINGRAY INSULATORS

Telephone-Telegraph

Export Agents: International Standard Electric Corporation, New York City

Electric & Gas in 1941. He began his utility career in 1919 as engineer with the Penn Public Service Co., predecessor of the Pennsylvania Electric. In 1937, while continuing as vice-president of that company, he was moved to Erie, Pa., and was made president of the Erie Lighting Co., the position he held until he associated with NYSEG.

Mr. Milliken was associated with the New Bedford (Mass.) Gas & Edison Light Co. from 1922 until 1939, and advanced from a results engineer in the power plant to assistant and then manager of the electric department of the company and then to assistant general manager. He was made a vice-president and became manager of NYSEG's eastern division in 1939.

•

S. M. Stewart Made Head of Stewart Iron Works

Announcement has been made of the election of Stanley M. Stewart as president of the Stewart Iron Works Co., Cincinnati, Ohio. Mr. Stewart's father is Robert S. Stewart, chairman of the

Carlson

board, and his grandfather, Richard C. Stewart, deceased, was the founder of the company.

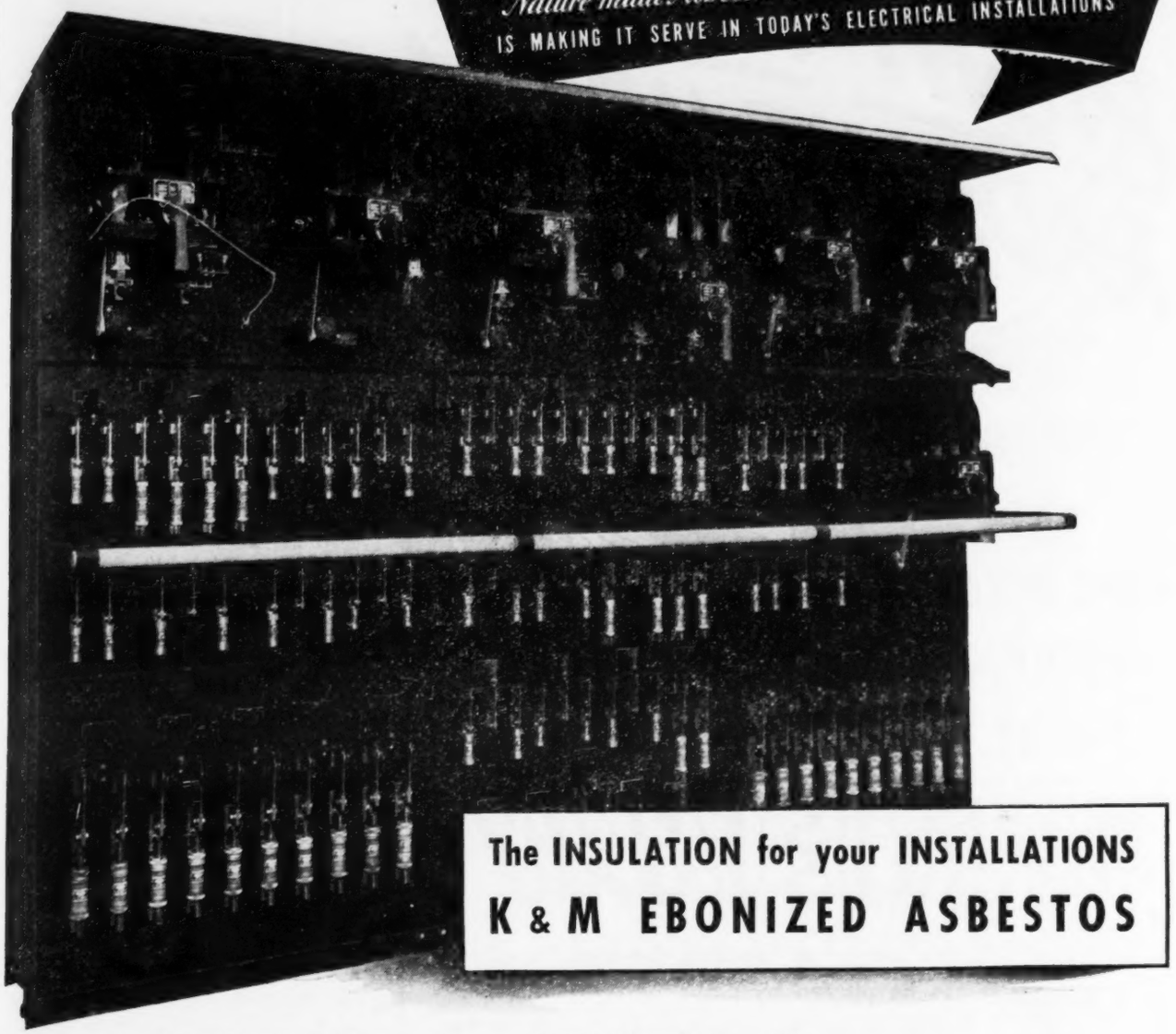
Following graduation from the University of Pennsylvania in 1930, Stanley Stewart, the new president, took a minor position in the plant. Following his apprenticeship in the manufacturing end of the business, he served in several office positions to become assistant secretary and advertising manager, the position he held at the time of his election to the presidency.

•

► VICTOR SIEGFRIED, assistant professor of electrical engineering, Worcester (Mass.) Polytechnic Institute, has been appointed chief research engineer, electric cable works, the American Steel & Wire Co., Worcester.

Courtesy I.T.E. Circuit Breaker Co.

Nature made Asbestos ... HERE'S HOW KEASBEY & MATTISON IS MAKING IT SERVE IN TODAY'S ELECTRICAL INSTALLATIONS



The INSULATION for your INSTALLATIONS

K & M EBONIZED ASBESTOS

● Use K&M Ebonized Asbestos for your electrical installations. It's made especially for modern electrical usage . . . switchboards, bus bar runs, testing tables, panel boards. It's a tough insulating material, made of a perfectly proportioned combination of asbestos fibre, binding cement and insulating compound, molded under intense pressure into strong monolithic sheets.

Here are the special features of K&M Ebonized Asbestos . . .

Exceptionally high dielectric strength.
Uniform density throughout.
Withstands severe shock, vibration and wide temperature variation.
Resists oil and water action.
Does not shrink, crack or bulge.

K&M Ebonized Asbestos is available for prompt delivery. Comes in thicknesses from ⅛" to 4", standard or special "panel" finish. Specially developed to meet technical requirements of the Underwriters Laboratories, Inc., when built into an assembled unit.

ARMY E NAVY
K&M
best in asbestos

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

IT'S THE RIGHT KIND OF RADIANT HEAT!

INFRA-RED EQUIPMENT MANUFACTURERS and PAINT MAKERS CAN AGREE ON

PENETRAY

No longer is "passing-the-buck" a game to be played by paint men versus equipment men. No longer is the "buyer" in the middle as to whether paint or equipment is responsible for unsatisfactory results.

Penetray's exclusive ceramic coating improves wavelength, producing more intensive color, thorough curing and superior polymerization on metals. In addition, insect attraction is minimum because glare is reduced and improved uniformity of energy distribution results. Prove these points. Make your own tests for color and gloss; for corrosion and abrasives.

SALES ENGINEERS WILL CALL or DETAILS on REQUEST

LEARN TO SAY »PENETRAY«

VERD-A-RAY CORPORATION ▫ TOLEDO 5, OHIO

OBITUARY

Lewis E. Myers

Lewis E. Myers, public utility executive and founder of the L. E. Myers Co., public utility construction and operating firm, died in Chicago January 5 after an extended illness at the age of 82.

Born and educated in Pittsburgh, Pa., Mr. Myers began his business career in 1885 as salesman for Thomas A. Edison, in that city. He went to Chicago in 1888 as manager of the Detroit Electric Works leaving that organization in 1890 to found the L. E. Myers Co. of which he served as president until 1930. At the time of his death he was chairman of the board. He has served as an officer and director of several other corporations, including president of the Lake Superior District Power Co. and the Michigan Gas & Electric Co.

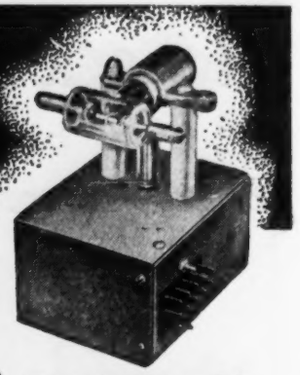
Among the important undertakings directed by Mr. Myers was the installation of the first electric multiple-unit control system for the Chicago Elevated Railway in 1894 and the first combined steam and electric railway in the United States, built for Wellston and Jackson Railway Co. of Ohio in 1898.

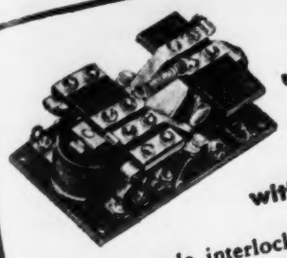
Prominent for his work in civic and welfare life, Mr. Myers has been chairman of the Salvation Army's Central Division since 1918. He was chairman of the National Council for Defense for Cook County (Ill.) during the 1st World War and in 1930-31 served as vice-chairman of the Governor's Commission on Unemployment. He was also a member of the Edison Pioneers.

•

▶ Raymond S. Kelsch, well known as an electrical engineer both in this country and Canada, died on February 4 in Montreal in his eighty-third year. Born and educated in Chicago, Mr. Kelsch spent some time in the communications field before joining the Chicago Arc-Light & Power Co. where he became general superintendent and chief engineer. He remained with this company until 1892, when it was bought by the Chicago Edison Co. He stayed with the reorganized company as superintendent of shops, high tension power plants and underground conduit and cable systems until 1897, when he resigned. He went to Montreal to superintend the erection and operation of the Lachine Rapids Hydraulic & Land Co.'s power houses and distribution system, serving as general superintendent and chief engineer of the company until 1903, when it was purchased by the Royal Electric Co. He was retained by the late Sir Herbert Holt as consulting engineer to consolidate the ten plants and properties of the

FIVE OF THE 5,312 RELAY TYPES





A NEW "MEMORY" RELAY

with simplified interlock

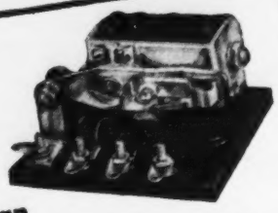
A new style interlock represents latch-in relay construction in its simplest, most dependable form. Design of this Struthers-Dunn 50XBX series simplifies make-before-break, or break-before-make contact combinations. Contacts do not interrupt coil circuit until the "throw" is completed and they are latched in new position. Built to aviation specifications.

VACUUM SWITCH KEYING RELAY

The extreme reliability with which this Struthers-Dunn Type 78CCA100 Vacuum Tube Keying Relay holds its adjustments is the direct result of a rigid and simplified design utilizing an absolute minimum of parts. Exceptionally sturdy—designed for aircraft. All parts readily accessible.

7 poles including one D.T. pole handling high-voltage r-f currents by means of a vacuum switch. High-voltage parts rounded to reduce corona.

SENSITIVE SNAP-ACTION



in a new, simplified design

Applications for the Struthers-Dunn Type 79XAX Sensitive Snap-Action Relay range from vacuum tube circuits, to overcurrent protection, pulsing circuits, and jobs where extremely close differential or extreme sensitivity are required. Contacts remain in position *with full pressure* up to the instant of transfer. Write for Bulletin No. 251.

SHOCKPROOF to 90 G's

Here's a relay that won't operate unintentionally as a result of shock or vibration—the Struthers-Dunn Type 17AXX designed to meet exacting B2A specifications. Small in size, light in weight, it meets and exceeds all specifications for such services.

EXTRA HEAVY-DUTY CONTACTS

Struthers-Dunn Nutcracker Type 61HXX100 meets the call for relays for extreme services, particularly where severe overloads may cause trouble on units having a less generous heavy-duty contact safety factor. Typical applications include those such as aircraft landing light controls, or controlling a number of solenoids simultaneously. Readily adaptable to different specifications.

WRITE—*for your copy of the big Struthers-Dunn Relay Catalog and Data Book . . .*

STRUTHERS-DUNN, INC., 1321 ARCH ST., PHILA. 7, PA.

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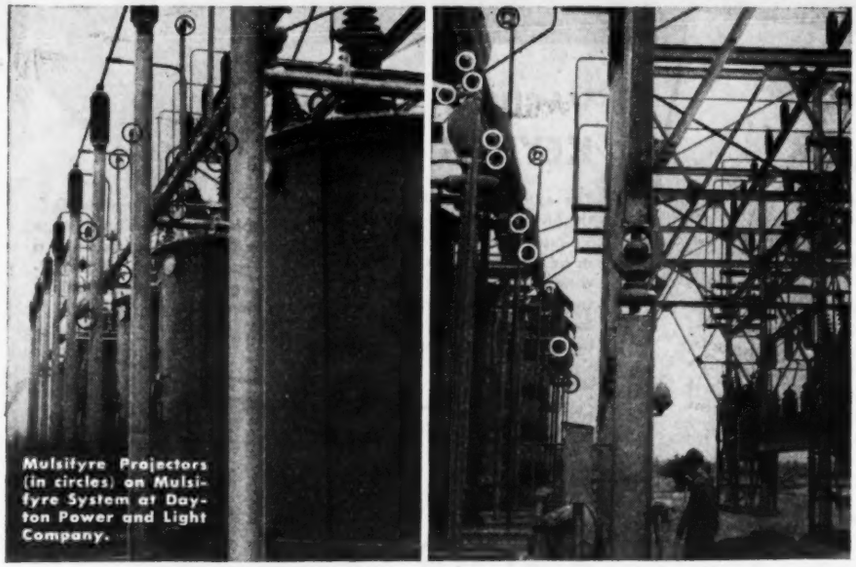
5,312 RELAY TYPES

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DALLAS • DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO • WASHINGTON

NO SERVICE INTERRUPTION
after bad transformer flare-up



Mulsifyre Projectors (in circles) on Mulsifyre System at Dayton Power and Light Company.

GRINNELL MULSIFYRE SYSTEM
averts disaster by immediate action

"PRACTICALLY NO DAMAGE FROM FIRE", was the report of The Dayton Power & Light Co. on a serious flare-up that resulted from an electrical failure on one of their substation step-up transformers. 35 FOOT FLAMES were extinguished so quickly by the Mulsifyre System that adjacent transformers were unaffected. THIS IMMEDIATE, DEPENDABLE ACTION is the reason why leading utilities have chosen Grinnell Mulsifyre Systems for protecting over 10,000,000 KVA of transformer capacity, and many other installations of similar oil-filled equipment.

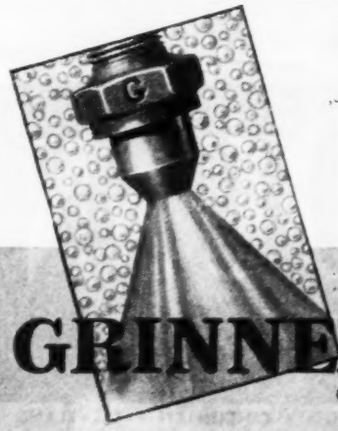
MULSIFYRE SYSTEMS operate on the principle of emulsifying blazing oil with a driving spray of water. The oil is turned into a liquid which is incapable of burning. Fire is extinguished in a few seconds and reignition is prevented.

Complete separation of water and oil takes place in a few hours ... leaves oil undamaged.

There is absolutely no conductivity along the discharge of a Mulsifyre projector when spray strikes conductors carrying high voltages.

Mulsifyre Systems are permanently installed ... they operate automatically or manually.

Recommended by Underwriters' Laboratories for use in extinguishing fires in flammable oils immiscible with water, wherever such oil is a fire hazard – in transformers and other oil-filled electrical equipment.



See that your equipment has this 24-hour-a-day protection, before fire strikes. Experienced Grinnell engineers will help you plan protection for your specific needs.

GRINNELL COMPANY

Executive Offices, Providence 1, R. I.
Branch offices in principal cities.

GRINNELL *Mulsifyre*

AUTOMATIC FIRE PROTECTION

company, which later became the Montreal Light, Heat & Power Consolidated. Mr. Kelsch was retained as consulting engineer by several light, power and industrial companies. He retired in 1926. He was a past-president of the Canadian Electrical Association, was a fellow of the American Institute of Electrical Engineers, and a member of the Institution of Electrical Engineers (Great Britain).

▶ HAROLD L. HUBER, engineer in charge of relations with electric utility and other wire-using companies for the American Telephone & Telegraph Co., died on February 4 at his home in Manhasset, L. I., after an illness of several months. He was 56 years of age. A telephone employee all his life, Mr. Huber began his career in 1913 as an inspector for the Chesapeake & Potomac Telephone Co., Baltimore, upon completing studies at Cornell University. Within four years he became district plant engineer and following service in World War I as a first lieutenant in the Army Signal Corps, he returned to the company. In 1927 he was appointed engineer on foreign wire relations by A. T. & T. Mr. Huber was a member of the American Standards Association, the American Institute of Electrical Engineers and served on the national committee of the International Electrotechnical Commission.

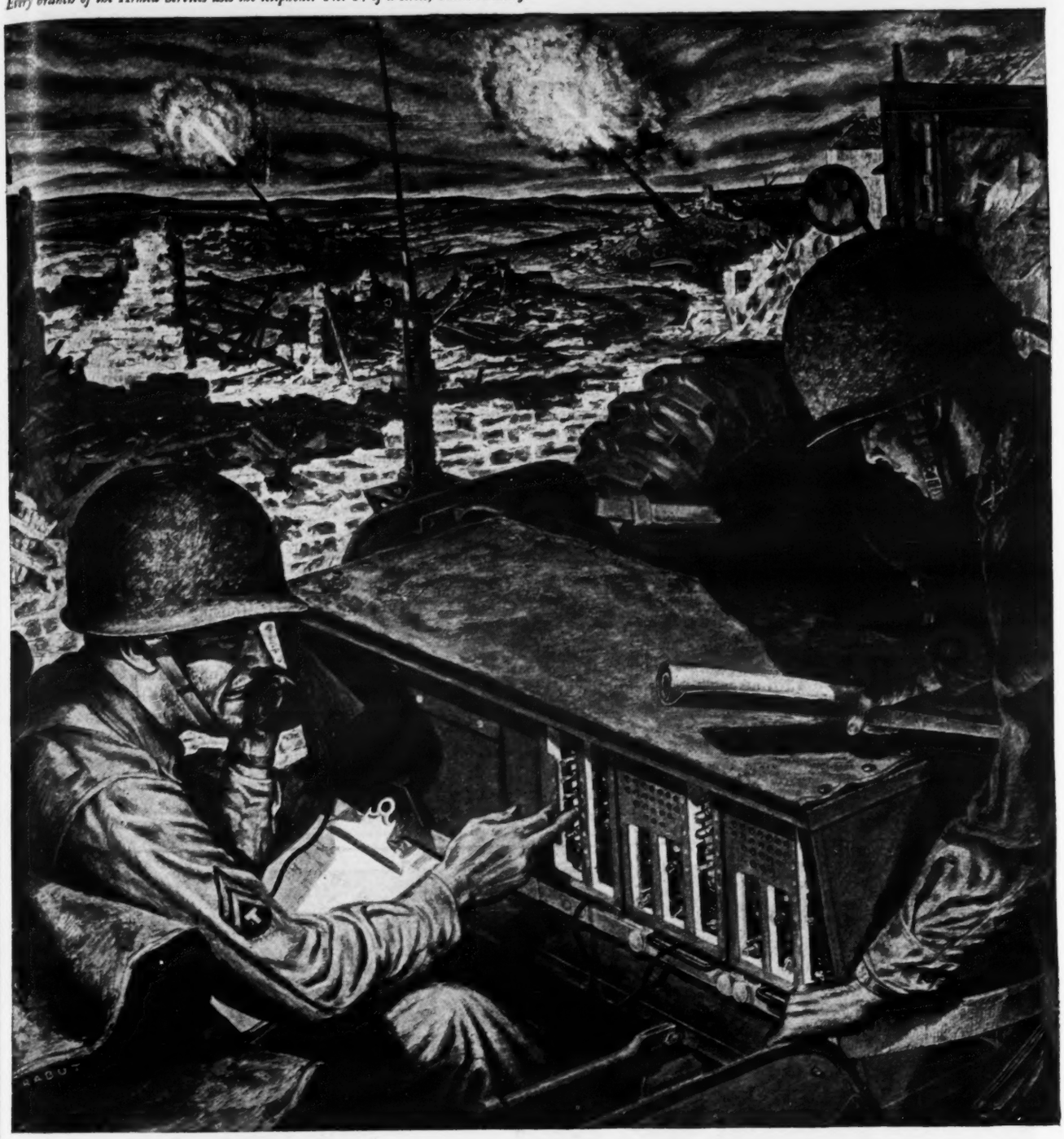
▶ CHESTER H. THORDARSON, founder of the Thordarson Electric Manufacturing Co., Chicago, died on February 6 at the age of 88. Mr. Thordarson came to the United States from Iceland in 1873, and settled on a farm near Windsor, Wis. Entering the electrical industry, he was one of the first to manufacture electric transformers at his factory founded in Chicago in 1895.

▶ T. CARLTON ERVIN, district manager of the Florida Power Corp., in St. Petersburg, died on January 21 in an Orlando hospital at the age of 49, after a long illness. Mr. Ervin had been associated with Florida Power Corp. since 1919.

▶ PAUL W. ALBERT, assistant chief engineer of the Louisville (Ky.) Gas & Electric Co., with which he was associated for 32 years, died on January 19 after suffering a heart attack while at work.

▶ CLAUDE A. KITTREDGE, who retired in 1943 as Gadsden district manager of the Alabama Power Co., died on February 1 at a hospital in St. Petersburg, Fla. He was 65 years of age.

Every branch of the Armed Services uses the telephone. No. 14 of a series, Field Artillery.



Long Toms—blasting unseen targets—are directed by voices flashing through this artilleryman's radio telephone "switchboard." Using its 10 channels, he connects the commander with spotters up front and in planes; then with battery commanders who focus tremendous firepower. He is helping soften up the long, hard road ahead.

★ ★ ★ ★ ★

Western Electric

IN PEACE...SOURCE OF SUPPLY FOR THE BELL SYSTEM.
IN WAR...ARSENAL OF COMMUNICATIONS EQUIPMENT.

Message for YOU!

Every time a 155mm "Long Tom" is fired, it costs Uncle Sam $37.78. Our leaders believe in using vast numbers of costly shells to prevent losing priceless American lives. Help provide the ammunition—*invest all the dollars you can in War Bonds!*

MANUFACTURING MARKETS

Advises Ways to Cut Costs of Equipment

Three suggestions for keeping down the cost of equipment for electric utilities in the post-war period are given in a report, "Prospecting for Apparatus and Merchandise," prepared by Tom Fort, manager Central Station Sales Department, Westinghouse Electric & Manufacturing Co., for presentation before the Public Utility Group of the National Association of Purchasing Agents.

The meeting was called off at the request of War Mobilization Director Byrnes to curtail travel, but the report has been released for publication.

Pointing out that the solution to post-war prices may be found in wartime conditions, Mr. Fort said that with labor costs up 40 percent and material costs also higher, manufacturers have been able to produce many items of electrical apparatus at lower prices than before the war. This is true because of increased volume, improvement in manufacturing processes, and concentration on standardized equipment.

As to what can be done cooperatively about these three items of cost, Mr. Fort advises:

First—increased volume can only come by increasing the use of electric power. The utilities and the manufacturers must join hands to promote in every way possible the greater use of electric power.

Second—improvement in the use of manufacturing facilities. This is a job for the manufacturers. The competition is so keen between electrical manufacturers that there need be no fear of their failure to improve continuously their manufacturing operations.

Third—the increased use of standardized equipment. Here is a job in which those who purchase for electric utilities have the major responsibility. By purchasing as much equipment as possible in accordance with standardized industry specifications, the economies of quantity production can be brought to many lines which heretofore have been individually manufactured.

Mr. Fort also explained market conditions on the various fields of electrical equipment used by utilities.

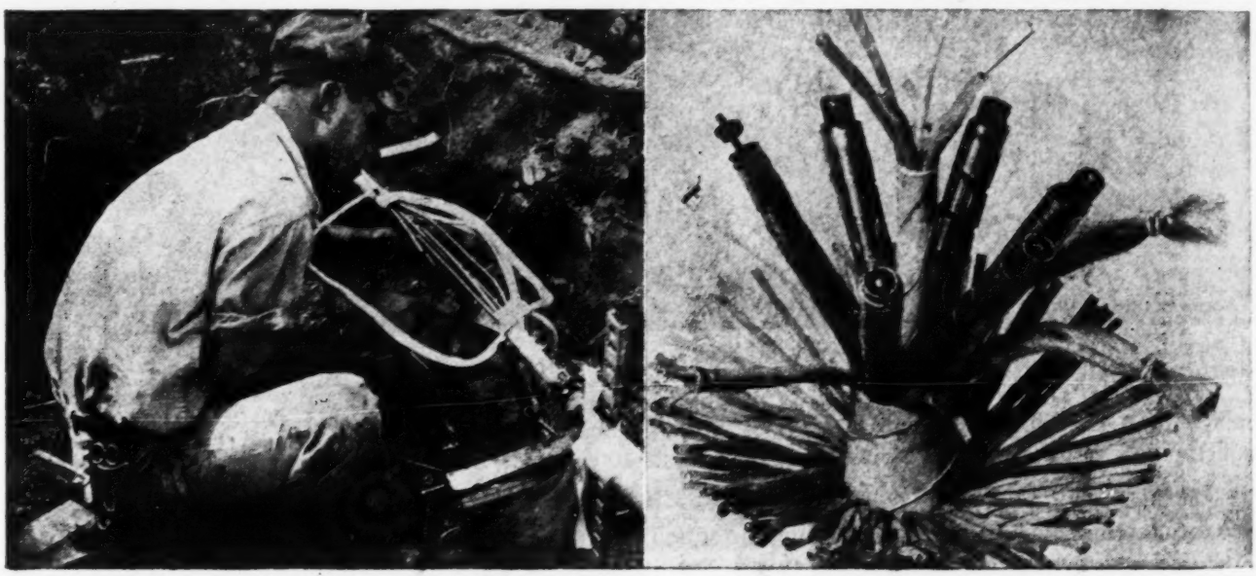
•

Permits Continued Range Production

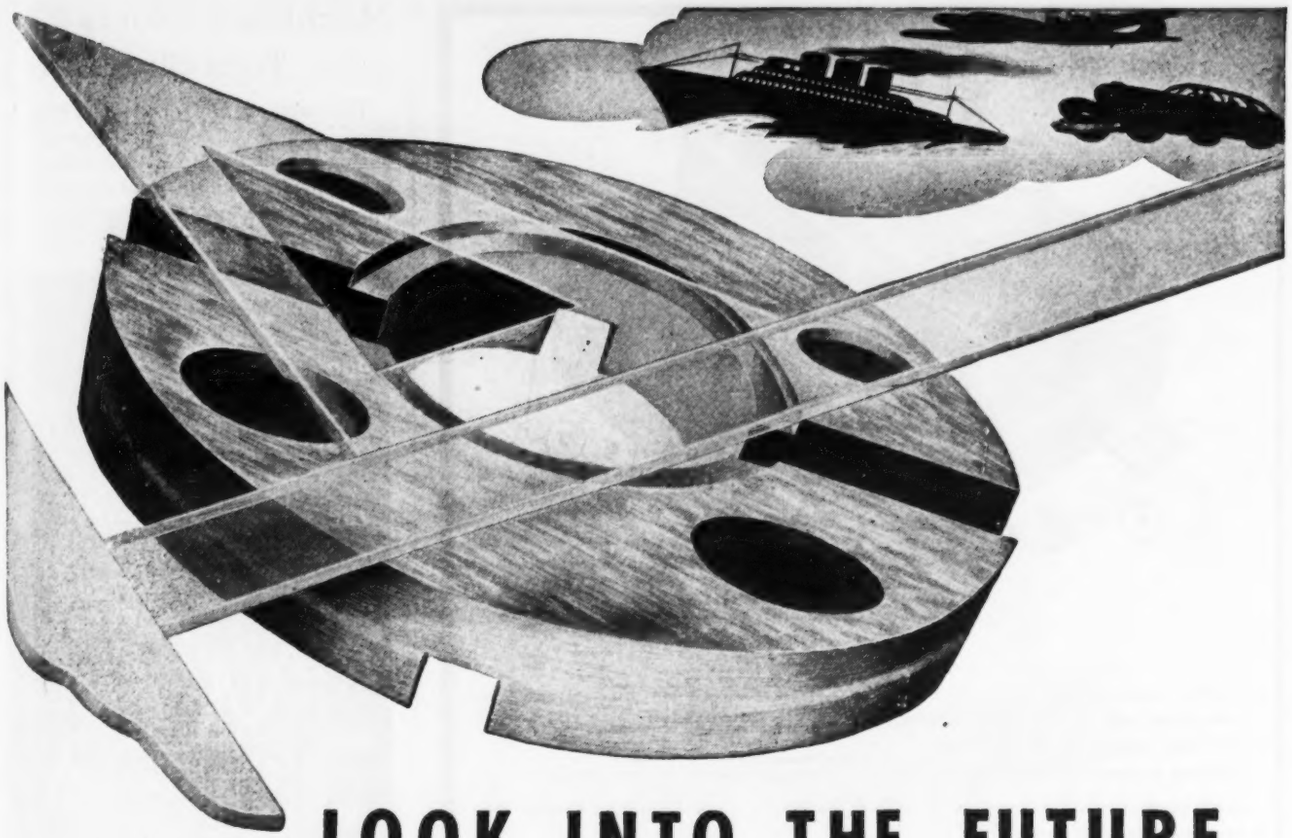
Temporary authorization to continue production of electric ranges, fans and irons has been given manufacturers who were authorized to produce these items last year but who have not yet obtained necessary labor authorizations for 1945 production, WPB announced this week.

Any items authorized for production last year which are completed this year will be included in the 1945 quota, WPB made it clear. WPB has approved production of 35,000 domestic electric ranges, 25,000 domestic and commercial electric fans and 526,500 electric irons in 1945. About 35 percent of the ranges will go to the armed services and the National Housing agency the remainder to institutional and domestic users who can certify to their need and show that no extra wiring will be required. No fans will be available for domestic use, but most of the irons will go to civilians.

Meanwhile, WPB authorized the Malleable Iron Range Co., of Beaver Dam, Wis., to manufacturer 3,750 three- and four-burner domestic ranges in the first two quarters this year.



FOR TELEVISION NETWORKS—Communication services by means of approximately 7,000 miles of coaxial cable is contemplated within the next five years by the American Telephone & Telegraph Co. Several hundred miles of this type of cable are now installed. At left, a splicer forges a new link in the Bell System's nation-wide communications network as he splices a section of the coaxial cable now being laid between Atlanta, Ga., and Jacksonville, Fla. At right, a fanned-out view of the six-coaxial cable which contains one layer of 21 quads outside the coaxials themselves, plus service pairs next to the coaxials. The coaxial program is to augment the existing telephone network and will be suitable for television transmission network. It will be possible to transmit a 4,000,000-cycle band for television plus 480 telephone channels simultaneously over the same conductors



LOOK INTO THE FUTURE...

The VULCOID part illustrated is a magneto coupling. It must have great mechanical strength, be moisture resistant, insulate electrically; and have sufficient resilience to absorb the shocks of starting and stopping.

When you are projecting your future products Continental-Diamond Technicians can help you design for the appropriate NON-metallic material.

C-D manufactures 6 distinctly different types of NON-metallic materials. These materials have helped solve thousands of mechanical, electrical, chemical and thermal design problems.

Whether your requirements dictate *plastics, vulcanized fibre, mica* or some other type of NON-metallic material C-D "Know-how" can help you.

KC-45

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DILECTO—A Laminated Phenolic.
CELORON—A Molded Phenolic.
DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.
HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE
VULCOID—Resin Impregnated Vulcanized Fibre.
MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

Descriptive Literature

Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

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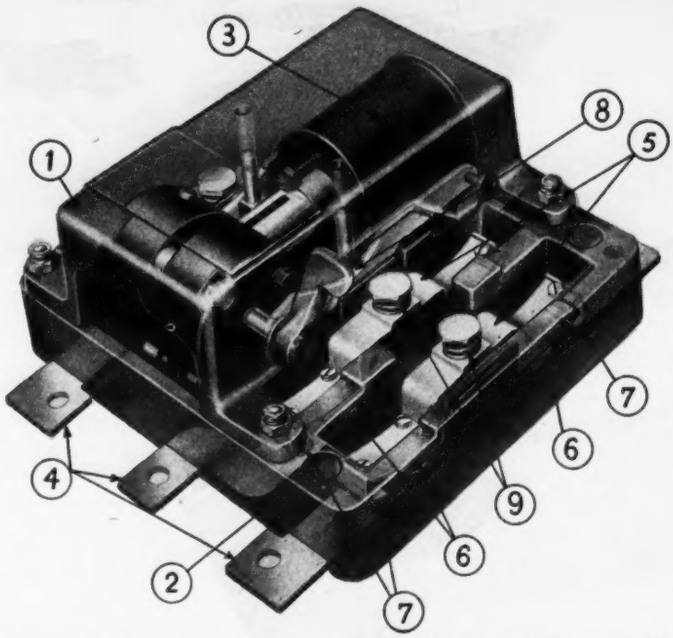
WEST COAST REPRESENTATIVES
MARWOOD LTD., SAN FRANCISCO 3

IN CANADA:
DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO 8

Continental-Diamond FIBRE COMPANY

Established 1895.. Manufacturers of Laminated Plastics since 1911—NEWARK 15 • DELAWARE



1—Metal frame housing
2—Moulded base of arc-resisting material
3—Single, momentarily energized coil
4—Heavy renewable plates for fixed contacts
5—Heavy copper bridges for movable contacts
6—Heavy silver main contacts
7—Separate arc tips provided
8—Simple manual operator
9—Beryllium copper contact springs

Listed by Underwriters' Laboratories for general use and for use with gas-filled tungsten filament lamp load, full rating.

Let's Discuss a REAL Remote Control Switch

(Electrically Operated — Mechanically Locked)

This ASCO "Type R.C." Remote Control Switch is built for dependability . . . for efficiency . . . for durability. Consider its major design and operating features.

Evaluate these features in terms of the objectives you have in mind for your remote control of power and lighting loads.

ASCO Electrically Operated SWITCHES

Include

Automatic Transfer Switches
Remote Control Switches
Contactors Relays

Your knowledge of electrical circuits and the "musts" in a remote control switch will place these "Type R.C." Switch features pretty well up at the top.

It's available in this design to 200 amperes and in similar designs to 1000 amperes.

We also manufacture a complete line of Solenoid Operated Valves for Automatic and Remote Control of Liquids and Gases

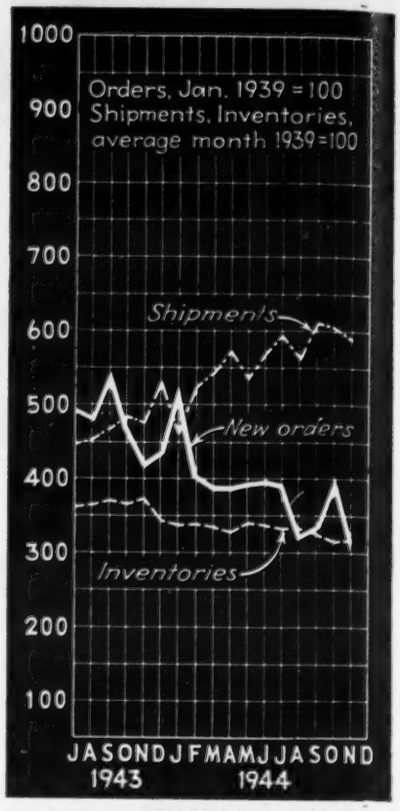
Automatic Switch Co.

41-E East 11th Street, New York 3, N. Y.

2-AS-6

Machinery Orders Take Sharp Drop

The value of new orders received by manufacturers of electrical machinery during the month of November dropped precipitously from the total reported for the month of October, according to the figures released by the Bureau of



ELECTRICAL MACHINERY INDICES of Bureau of Foreign and Domestic Commerce

Foreign and Domestic Commerce. The index compiled by the Bureau fell to 314 from 401 in October. It stood at 423 in November, 1943.

Electrical machinery shipments index lost some ground in November, falling to 589 from 604 in October. This compares with 477 in November, 1943.

Electrical inventories remained practically unchanged in November, the index compiled by the Bureau standing at 319.3; October, 318.6; November, 1943 at 374.5.

•

Osmose Wood Preserving Moves Branch Offices

New branch office locations have been announced by Osmose Wood Preserving Co. of America, Inc. The Chicago office, formerly located at 14 East Jackson Blvd., has been moved to new quarters at 322 South Michigan Ave., Chicago 4, Ill. The Denver office, until recently at 821 E. & C. Building, is now at Tower No. 2, Continental Oil Building.

—BEHIND *EVERY* LIGHTING PLAN . .

IS THE NEED FOR

ADEQUATE WIRING . .

ELECTRICAL ENGINEERS

Business publications like these, with aggregate circulation of over 240,000 monthly among your prospects and customers, carry Wiremold advertising messages designed to HELP YOU BUILD BUSINESS. Tie in with this aggressive promotion program.

NEMA

THE WIREMOLD CATALOG IS YOUR GUIDE TO WIRING PLANNED FOR TOMORROW'S NEED

Versatile Wiremold Raceways and Fittings efficiently meet the installation requirements of all modern lighting systems . . . whether incandescent, fluorescent or other newly developed light sources are used. In the Wiremold Catalog and Wiring Guide you will find the many sizes of raceway and the full range of fittings needed to plan either a complete basic wiring layout for new building construction or the wiring extension and relocation necessary in modernizing existing installations. Wiremold methods and materials are not new to you. They were your standby in prewar years. They have been widely used to speed work, save time and step up lighting standards in war plants throughout the nation. They stand ready now to become an essential part of your post-war business planning. If you have not received a copy of Wiremold Catalog No. 16A, write us at once.

THE WIREMOLD COMPANY, ARMY E NAVY **HARTFORD 10, CONN.**

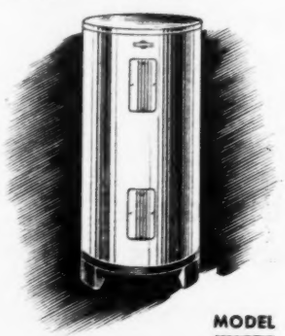
YOUR POSTWAR *Consumer*

WILL WANT *More* HOT WATER

All signs point to a big increase in postwar domestic use of hot water facilities. Widespread popularity of automatic dish washers and home laundry units is expected to create an unprecedented market for electric water heaters. In fact, recent surveys indicate a postwar demand for over one million units by mid-1946!

Electromaster—with an established load building reputation—can assist in your postwar program. Electromaster Water Heaters provide a quality, economical product to meet consumers' requirements. Electromaster Water Heaters offer a dependable, service-free load building unit.

Include Electromaster in your postwar plans.



MODEL W60R2

ELECTROMASTER WATER HEATERS

feature such outstanding advantages as precision-made, direct-action automatic thermostats and leakproof flange fittings on heating units. Output of the thirty, sixty and eighty gallon sizes will begin as soon as possible.

ELECTROMASTER INC.
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Field Reports on Business

Machinery orders being placed to meet Government requirements for repair and spare parts include considerable electric supplies. Manufacturers report big demand for industrial war plant equipment. Utility distribution circuits damaged in last week's storm presage additional purchases of line material. Retail trade continues brisk.

PACIFIC COAST

The recent price increases of 5 and 10 percent for rigid and thinwall conduit respectively, affected Pacific Coast sales volume very little, as wholesalers racks are low.

Eastern fuel shortage has hampered mills and manufacturers so that factory shipments are now approximately 30 days and 60 days for rigid and thin respectively. Rubber-covered wire orders will have to depend upon the fairly good though spotty coast stocks for awhile, manufacturers having been pre-empted for very large Signal Corps orders to replace European War needs.

Machinery orders include many repair and spare parts, such as $30,000 coils for San Francisco street railway; $65,000 parts for Mare Island; and $40,000 maritime fittings for a North Bay yard. Two 1,000 kw. rectifier equipments, including cable and switchgears, totaling $105,000 have been shipped to Hawaiian Islands.

New government construction covers heavy material warehouses for Mare Island, and electrical and sprinkler systems for many air depots and hospitals. Workers for Columbia Steel's $6,000,000 enlargement at Pittsburgh will be mostly housed in a nearby abandoned army camp and 1,000 war dwellings will be built near Douglas Aircraft at Long Beach. Other industrial developments largely concern the oil industry, such as Union Oil's $1,000,000 extensions at Wilmington for shops and warehouses and $400,000 additions to Standard's El Segundo installation. A site is being sought for American Smelting & Refining Co. $8,000,000 zinc refinery, with the Lower Columbia River and Tacoma as prospects. Los Angeles has ordered three 5,000 kva. Pennsylvania transformers costing $27,066, and Ketchikan, Alaska, has rejected all bids for its proposed Beaver Falls power plant, the lowest being $474,784.

NEW ENGLAND

Heavy wet snow with wind on February 8 damaged many utility distribution circuits in eastern New England, presaging additional purchases of line material by companies with low stocks of wire and pole fittings. Wholesalers anticipated at least a short rush of orders immediately after the storm, but transportation difficulties handicapped movement of both personnel and vehicles, notably in eastern Massachusetts.

Manufacturers' representatives report great activity in demands for industrial war plant material, and consulting engineering offices are busy on propositions in this field. Western Massachusetts Electric Co. is making careful plans for postwar load building, property extensions and operating improvemens. In the real estate field, it is expected that efforts will be made to procure more oil burning equipment this year for apartment house use, involving electrical facilities to be installed before another winter.

At the Cabot hydroelectric station in Turners Falls, Mass., $74,233 has recently been expended on major repairs to foundations. Raytheon Mfg. Co., Waltham, Mass., has just announced its intention to keep going at full blast on civilian electronic needs after the war, and has already applied for a permit to build a major television station on Prospect Hill, Waltham, at a point in the clear between Metropolitan Boston and the upland areas in west-central Massachusetts and southern New Hampshire. A decision of the SEC refusing to order the New England Public Service Co., Augusta, Me. to dispose of five important textile mills identified with this utility group, leaves the engineering and purchasing of electrical and other equipment in present hands.

NEW YORK

The backlog of unfilled orders continues to increase as the demands of war mount.

As a result of severe weather, freight embargoes and manpower shortages the steel industry suffered last week one of its most drastic production set-backs since the war started.

Civil engineering construction volume in continental United States totaled $20,591,000 last week. This volume was 28 percent lower than in the preceding week and 11 percent below the total reported by *Engineering News-Record* for the corresponding 1944 week. Private construction topped the preceding week by 16 percent and was 102 percent higher than in the corresponding week last year. Public construction was 44 and 36 percent lower, respectively, than a week ago and a year ago, due to the decreased volume of federal work. The week's construction brought 1945 volume to $137,500,000 for the six weeks, a decrease of 36 percent from the $215,192,000 reported for the 1944 period.

CHICAGO

While the pace of industrial production in the Chicago area among manufacturers of all types have been stepped up to a marked degree since the first of the year to meet war demands, activity of electrical manufacturers, as indicated by recent bookings from government agencies, continues in the forefront. Active lines include radio and radar equipment, wire and cable, electrical plugs and receptacles, and voltage regulators.

During the week ending January 31, Hallicrafters Co., received a $52,100 Navy Dept. order for radio receiving sets. Also from the Navy was an order booked by W. H. Salisbury & Co. for an undisclosed number of rubber blankets, and another for $7,930 worth of X-Ray and dark room equipment awarded to the G.E. X-Ray Corp.

American Phenolic Corp. received a contract for $178,608 worth of receptacles and plugs from the Aviation Supply Office, Philadelphia. From this source also came an order aggregating $24,000 for "cable" booked by Belden Mfg. Co. and one for $3,735 for wire received by Lenz Electric Mfg. Co. A contract for 15,000 headsets aggregating $180,000 was awarded to Permoflux Corp. by the Aviation Supply office as was an order for 10 automatic voltage regulators by Solla Electric Co.

CONFIDENTIALLY

There never *has* been any better time-lag fuse than a SHAWMUT SHUR-LAG RENEWABLE FUSE. It has always been the fuse of today for tomorrow; the simplest, the sturdiest, the most speedily and easily renewed; in short, the fuse to use. To save shutdowns and delays in production, and completely protect your circuits and equipment, order SHUR-LAG and be sure.

THE CHASE-SHAWMUT COMPANY

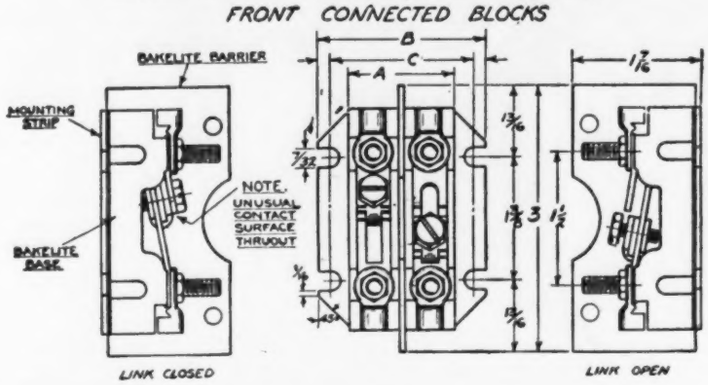
NEWBURYPORT, MASSACHUSETTS

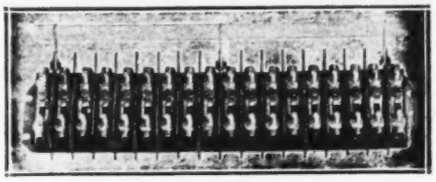
FUSE MAKERS SINCE 1893

STATES TESTING EQUIPMENT

2 IN 1
Type NT *Sliding Link* Terminal Blocks
Are Test Blocks Too!

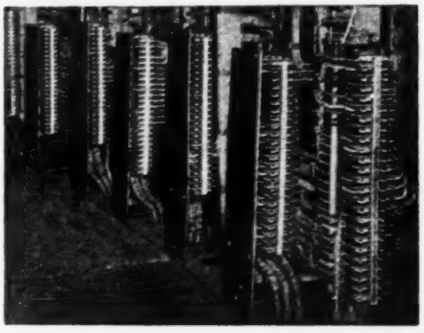
A good way to terminal wires, and an easy way to check circuits without disturbing permanent wiring.





From 1 to 60 poles

States Type NT Blocks may be obtained in any number of poles to 61, front or back connected with or without cover, with or without marker or codeing strip.



Here is an excellent method for terminating incoming cables and panel connections. Type NT Blocks may be placed in any position, they seem to best fit—and they fit into out of the way places when you are cramped for space.

(See cut to right)

For complete information see Cat. 1, Sec. 6.

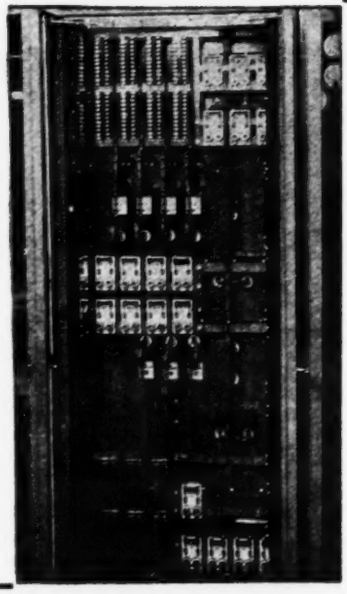
CHECK the FACTS

Any number of poles thru 60. Simplicity of codeing and testing crowded circuits.

Operated with screwdriver or hex wrench.

May be placed in any position that best fits location.

No parts to remove.



.....**Tear off and mail today**.....

to THE STATES COMPANY
3 New Park Ave., Hartford, Conn.

Please send copy of Cat. 1, Sec. 6 on Terminal Blocks to

Name..... Title.....

Firm .....

City..... State.....

Sales Opportunities

WISCONSIN—Wisconsin Electric Power Co., Milwaukee, has plans maturing for expansion in steam-electric generating station including addition to present building with installation of new 80,000-kw. turbine-generator and accessories, high-pressure boiler and auxiliary equipment. Project will include enlargement of switchyard and extensions in transmission lines, with power substations and other operating facilities. Cost estimated about $7,000,000. Application has been made for a priority rating and it is expected to begin work in spring.

TEXAS—Water & Light Department, Brownsville, plans reconstruction and modernization of municipal steam-electric power plant, with installation of new turbine-generator and accessories for increased capacity. Cost estimated close to $500,000. Proposed to arrange bond issue in that amount in near future. Understood this will be a post-war project.

NEBRASKA—Municipal Electric Department, Alliance, plans extensions in primary lines, for power supply for irrigation pumping operations. Application has been made for permission.

OHIO—Atmospheric Nitrogen Corp., Hopewell, Va., has contracted with government for expansion in ammonia plant to include a number of new buildings with machinery for large increased capacity, fractioning towers, turbo-blowers, electrical equipment, pumping machinery and other apparatus. Entire project is estimated to cost about $3,000,000, with financing to be provided by government. Company is affiliated with Allied Dye & Chemical Corp., 61 Broadway, New York, N. Y.

IOWA—Municipal Electric Department, Hawarden, has authorized plans for expansion in municipal electric plant, with installation of new 1,000-hp. diesel engine-generating unit, switchboard, transformers and miscellaneous equipment. Cost estimated close to $100,000. It is understood this will be a post-war project, and will include an addition to present building. Buell & Winter Engineering Co., Insurance Exchange Bldg., Sioux City, is consulting engineer.

CONNECTICUT—Board of Directors, Hartford Hospital, 80 Seymour St., Hartford, has approved plans for new power substation at institution, to be known as substation No. 1. Also for an auxiliary transformer station in basement of present laundry building, to be known as substation No. 4. Building permit is being secured. Coolidge, Shepley, Bulfinch & Abbott, 1 Court St., Boston, Mass., are architects for first mentioned structure.

TEXAS—Rheem Mfg. Co., 1401 Lockwood Dr., Houston, manufacturer of steel tanks, barrels, drums, etc., will carry out expansion in local plant for manufacture of steel shells for government. Work will include several additional buildings on adjoining site, with installation of furnaces, machinery and electrical equipment. Cost estimated about $3,000,000, with financing by Defense Plant Corporation. Proposed to begin work soon. Executive offices of company are at 570 Lexington Ave., New York, N. Y.

CALIFORNIA—Municipal Light & Power Department, Pasadena, plans extensions in transmission lines in different parts of city, to be carried out as a post-war development.

[*Advertisement*]

SYLVANIA NEWS
CENTRAL STATION EDITION

FEBRUARY *Published in the Interests of Better Sight and Sound* 1945

Sylvania "Long-Slim" Fluorescent Lamps Open New Possibilities

New Lamps Ideal for Continuous-Row Lighting and Wide Range of Decorative Applications

New, long, slim-diameter fluorescent lamps soon to be produced by Sylvania Electric will open new possibilities in the design of lighting installations.

The new lamps will come in 42" and 64" lengths of only ¾" diameter; in 72" and 96" lengths of 1" diameter. They will be of the instant-starting type, requiring no starter, and will use a single-pin base.

Because of their versatility, these Sylvania LS lamps offer new opportunities for more extensive decorative lighting. For example, they are well-suited for continuous-row installation in factories, schools, stores, and other buildings.

With proper selection of ballasts, they can be operated at either of two current ratings. This feature may encourage the installation of extra fixtures as night lights in stores and restaurants. Operated at the lower current rating for lower brightness, LS lamps may serve as a late-hour window display medium and as an added safety feature.

As yet the new lamps are available only in sample quantities. However, the data below will be helpful in recommendations for postwar installations.

Another addition to Sylvania's Fluorescent line is a 13-watt miniature lamp, of the conventional starting type, 21" long and ⅝" in diameter.

JUDGES AT WORK

Four judges and a Sylvania executive view entries in Sylvania fixture design contest. Foreground (L-R) Lurelle Guild, product design consultant; Allan Parker, Worcester Polytechnic Institute; Howard Sharp, Buffalo, Niagara & Eastern Power Corp. Standing (L-R) C. A. Carpenter of Graham, Anderson, Probst and White; Charles Goddard, Sylvania Electric.

Because of the large number of the entries, contest award winners will be announced in our March issue rather than February as originally announced.

THE NEW ADDITIONS TO SYLVANIA'S FLUORESCENT LINE

LS LAMPS	CURRENT MILLIAMPERES	APPROX. INITIAL LUMENS	LAMP LIFE HRS.
42" T6 (42", ¾")	100 200	900 1400	Life of LS fluorescent lamps at 200-milliampere operation is expected to be comparable to that of 40-watt standard fluorescent lamps. Definite ratings will be published as soon as life testing is conclusive.
64" T6 (64", ¾")	100 200	1400 2150	
72" T8 (72", 1")	100 200	1400 2350	
96" T8 (96", 1")	100 200	1950 3300	

MINIATURE LAMP	CURRENT MILLIAMPERES	APPROXIMATE INITIAL LUMENS	LAMP LIFE, HRS.*
21" T5 (21", ⅝")	160	Daylight . . . 490 White 580	1500

*Under specified test conditions

SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC., Salem, Massachusetts

MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

TIME TO RELAX?.. HELL, NO!

THIS is no time to start pulling up the old easy chair . . . not when we all know that only combined effort and all-out cooperation will speed the knock-out punch. Your iron and steel products are vital to the war effort . . . and they'll do a better job if you assure long-lasting protection by the PENNizing process of Quality Hot Dip Galvanizing. . . . PENNizing, the lasting protection against corrosion.

PENNizing is the process of revitalizing your iron and steel products by Quality Hot Dip Galvanizing as perfected by the Penn Galvanizing Company since 1910.

HOT DIP GALVANIZING • GALVANIZED IRON AND STEEL PRODUCTS FURNISHED

PENN GALVANIZING CO. *the Nation's Largest*

PICKLING AND PAINTING • PICKLED AND PAINTED IRON AND STEEL PRODUCTS FURNISHED

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PLANTS: No. 1, 2201 E. Tioga St. - No. 2, 2400 E. Tioga St. - No. 3, 3548 N. Sepviva St.

Royal-ettes #5 *in a series of informative news letters from a producer of Power Switching Equipment.*

TO the boys in our engineering department, a new idea in transmission accessories is as welcome as a new-born babe. As we said here two weeks ago, most of the items in our catalog originated as suggestions from our industrial and utility customers. Take our type PK dead end clamp shown on page 115 of our catalog.* It was Pete Knapp of Toledo Edison who suggested a type of dead end clamp that would hold G-E type SS aerial cable. At that time no satisfactory, inexpensive device was available. The clamp we doped out with him is now widely used all over the country. To users it meant a substantial reduction in the cost of dead ending this type of cable, and to us it meant an active addition to our line of products.

Type PK Dead End Clamp

* If you don't have one, let us send it to you now.

ROYAL ELECTRIC MFG. CO. 619 E. 40th Street CHICAGO 15, ILL.

Cost estimated about $75,000. Proposed to begin work at earliest possible date.

WISCONSIN—Civil Aeronautics Administration, 608 South Dearborn St., Chicago, Ill., will receive bids until March 2 for installation of lighting system at Rock County Airport, including 51-ft. beacon tower and beacon light, underground conduit system, 164 flush-type marker lights, transformer house, control equipment, etc. Plans and specifications on file at first noted office (room 2107).

CALIFORNIA—Pacific Tire & Rubber Mfg. Co., 4901 East 12th St., Oakland, will make extensions in mill for production of heavy-duty tires and tubes for army trucks and other military vehicles, comprising several one-story wing additions to present main plant, with installation of machinery and electrical equipment. Cost estimated about $1,000,000. Financing by Defense Plant Corporation. Work will begin at early date.

WASHINGTON—Pacific Power & Light Co., Portland, Ore., plans extensions in transmission and distribution lines. Application for permission has been made. Proposed to begin work soon.

OHIO—Seiberling Rubber Co., 345 15th St., Akron, has plans for new three-story addition to mill for manufacture of heavy-duty tires and tubes for military trucks and vehicles, with installation of machinery and electrical equipment. Cost estimated about $1,000,000. Work on superstructure is scheduled to begin at once.

KENTUCKY—War Department, Washington, D. C., has approved plans for expansion in Kentucky Ordnance Works, and Weldon Springs Ordnance Works, Missouri, for increased manufacture of explosives, comprising number of new one and multi-story buildings at both plants, with mechanical and chemical facilities, and electrical equipment for large output. Cost estimated about $2,000,000 for combined project. Rust Engineering Co., Clark Bldg., Pittsburgh, Pa., engineer and conrtactor, will be in charge of projects.

CALIFORNIA—Civil Aeronautics Administration, 1500 Fourth St., Santa Monica, has plans under way for installation of lighting system at airport including beacon tower and beacon, underground conduit lines, marker lights, transformer station and controls, and other electrical facilities. Bids are scheduled to be asked in near future.

FLORIDA—Municipal Electric Department, Jacksonville, has plans under way for expansion in municipal steam-electric generating station as a post-war project, including addition to building, with installation of turbine-generator and accessories, high-pressure boilers and auxiliary equipment, to cost approximately $5,000,000. Also for extensions in transmission lines in different parts of city, with new power substations and additions in certain present substations, to cost over $400,000.

INDIANA—War Department, Washington, D. C., has authorized expansion in Wabash Ordnance Works, for smokeless power production, comprising large group of one and multi-story buildings, with machinery and electrical equipment for heavy output. Also extensions in distribution system, transformer stations and other electrical facilities. Entire project will cost about $20,000,000 and will be carried out under direction of U. S. District Engineer Office, Chicago, Ill.

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. . . designed for tropical conditions
. . . unbeatable on ANY job

Standard Sprague Koolohm Wire Wound Resistors now offer the same high degree of humidity protection formerly obtainable only on special order to match exacting military specifications. This construction, newly adopted as standard, includes a glazed ceramic outer shell and a new type of end seal. These features give maximum protection against even the most severe tropical humidity conditions. Type numbers remain the same except for the fact that the letter "T" has been added to designate the new standard construction.

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Recent Legislation

ARKANSAS—A reorganization bill merging the state Corporation Commission and the state Department of Public Utilities into a new Arkansas Public Service Commission, has cleared the Legislature with House passage, 90 to 1.

INDIANA—A bill was introduced in the House which would exempt all municipally owned property from all taxation and also forgives all penalties and delinquencies. The bill carries an emergency clause and, if passed and signed by the Governor, would be in immediate effect. Another House bill would amend the municipal utility act to provide that cities of the fifth class, owning two or more municipal utilities, may establish a pension system for its employees. The bill was passed by unanimous vote and carries an emergency clause. A measure has been introduced in the Senate which would permit cities and towns to enter into contracts not to exceed 25 years for all types of utility service. The bill would give the authority to enter into the contract with the city board of works and provides that the city council shall adopt the proper ordinances. The bill applies to all cities of the first through the fourth classes. Another Senate bill prohibits employers from permitting employees to work near moving machinery or electrical equipment of 200 volts or more unless other workers are within sight and able to give assistance in event of accident. The bill provides a fine of $500 for violation.

OREGON—A Senate bill to prevent public utility districts from purchasing utility property outside of their own districts without the consent of voters of the area has been introduced by Senator Merle R. Chessman. Under existing laws a PUD in one town could buy utilities in another and then regulate the rates of the town in which the former private utility was located. The measure seeks to eliminate that possibility. People's utility districts and municipalities would lose their favored position in applying for hydro-electric projects under Oregon law in an amendment to the present hydroelectric act proposed in the House. Under the present act, providing issuance of licenses for 50 years by the state hydroelectric commission, the state or any other municipality may at any time take over private properties on payment of fair value and severance. A proposed change would make the takeover possible only after expiration of the license and on payment of net investment not exceeding fair value plus severance damages. In addition, two years written notice would be required. The commission would be given eminent domain rights in acquisitioning property deemed necessary for construction of dams, diversion structures and other parts of the project if the lessee failed to reach agreement with property owners. Requirements for putting excess earnings into an amortizing reserve would be placed in the "may" class instead of "shall" and would include surpluses accumulated in excess of a "reasonable return" only after expiration of 20 years on the license rather than all accumulated excess profits. Remonstrances against preliminary permits would have to be filed within 30 days after final publication of the application and if not served on the applicant, would be declared void.

NEW YORK—Under the provisions of a bill introduced in the Senate, amending Paragraph 364 of the General Municipal Law, municipal corporations furnishing public utility services need not decrease its

These Ducts
HAVE WHAT IT TAKES
—for reliable cableway service

Here are some outstanding reasons why J-M Transite Conduit and Korduct serve so well under the most severe conditions—

Inorganic . . . made of an asbestos and cement composition which provides permanence and strength, makes the ducts immune to rust or rot.

Permanently smooth bore . . . long cable pulls and replacements are made easier. Danger of damage to cables is minimized.

Easily and quickly installed . . . long, light-weight lengths and simple assembly method assure rapid, economical installation.

Immune to electrolysis . . . being entirely inorganic and non-metallic, these ducts are not affected by electrolytic or galvanic action.

Lower cable temperatures . . . an advantage resulting from a relatively high rate of heat dissipation.

Incombustible . . . won't contribute to the formation of dangerous smoke, gases, or fumes. If burnouts do occur these inorganic ducts provide maximum protection to adjacent cables and permit easy removal of damaged conductor.

* * *

For complete details on Transite Ducts, write for Data Book, DS-410, Johns-Manville, 22 E. 40th St., New York 16, N. Y.

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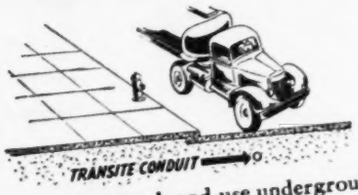

For exposed work and use underground without a concrete encasement.

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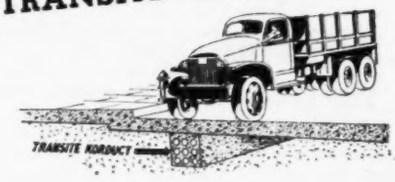

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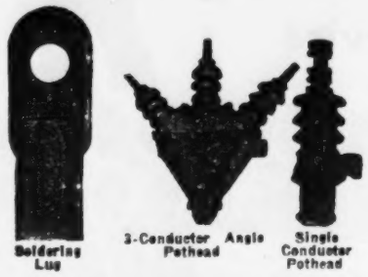

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Please mail me your Insto-Gas Bulletin and tell me how to furnish Priority rating. Send me name of nearest distributor.

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rates and charges on order of the Public Service Commission unless order is issued upon notice and after hearing instituted by not less than 25 active consumers residing in territory in which rates apply.

Recent Rate Changes

TORONTO HYDRO-ELECTRIC COMMISSION has reduced electric rates in Toronto approximately $1,583,000, Mayor Robert H. Saunders has announced. Domestic users will receive a cut of 12.4 percent in their bills; commercial users, 9.3 percent and industrial users, 12.2 percent. The Province of Ontario made a contribution to the reduction insofar as Ontario Hydro reduced power costs to the city by $505,000, and this saving will be passed on to the consumers. The amounts saved during 1945 will be: domestic, $570,000; commercial, $281,000, and industrial, $672,000. Pressure to obtain a rate reduction was begun last fall. Toronto Hydro had recommended reductions, based on 1943 operations, amounting to 10 percent for domestic users, 6.6 percent for commercial users, and 5.8 percent for industrial users. With the reduction by the Province of the $505,000 in the Toronto Hydro costs, the additional savings to consumers were effected. A review of Hydro rates in other Ontario municipalities is now under way.

GEORGIA POWER & LIGHT CO. has made a reduction in rates to commercial customers that will save them an estimated $35,000 annually. All commercial customers using more than 14 kw.-hr. monthly will benefit, Walter R. McDonald, chairman of the state Public Service Commission announced. He added the reduction would average 11 percent depending on the amount of electricity used. Action on a proposed change in the company's wholesale rate to REA cooperatives was deferred, Chairman McDonald said, pending further conferences with representatives of the company.

CALIFORNIA OREGON POWER CO. has been authorized by the California Railroad Commission to reduce its electric rates in northern California. Affecting electricity users in Shasta, Trinity, Siskiyou and Modoc counties, reductions were made possible by increased use of electric service, according to L. Harold Anderson, president of the commission. At the same time, lower electric rates were established by the company in territory formerly served by the California Public Service Co. A recent commission decision authorizing acquisition by California Oregon Power Co. of Public Service Company properties in the Alturas area provided that COPCO's lower rates be charged. Total reduction to Alturas customers average from 30 to 44 percent.

SOUTH CAROLINA ELECTRIC & GAS CO. has been requested by Mayor Fred D. Marshall of Columbia to reduce its commercial and residential rates in the Columbia area by 20 percent. The Mayor's request to the General Gas & Electric Co., parent of the South Carolina utility, followed an attempt on the part of city council to purchase the utility properties that was not consummated. The mayor said if the company declined the city would appeal to the state Public Service Commission.

SAUK CITY, Wis., municipal electric utility customers will save about $2,200 annually through rate reductions which became effective February 1, the state Public Service Commission has announced. The largest saving, amounting to $1,165, went to 414 residential customers.

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HIGHEST ACCURACY
CHRONOMETRIC
TACHOMETER

Readability to 1 RPM per division. Guaranteed accuracy well within ½ of 1%. Indicates RPM directly on the dial without any calculations over a fixed period of 6 seconds. Negligible torque. Two models with ranges 0-1000 RPM or 0-10,000 RPM, each suitable for double rated range.

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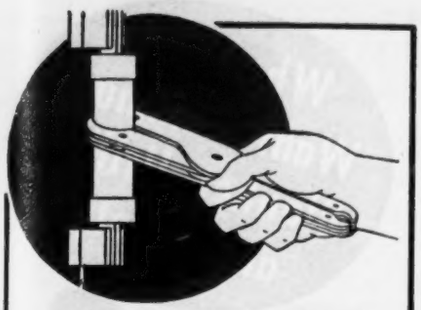

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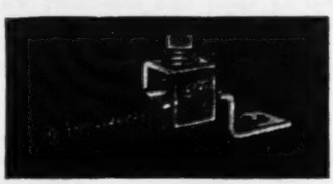

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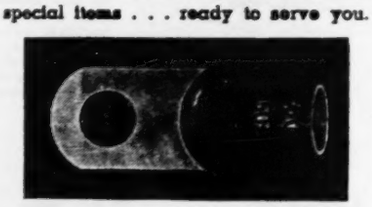

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ILSCO COPPER TUBE & PRODUCTS, Inc.
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REA Funds Allotted; Contracts Approved

Allotments totaling $989,000 to 16 cooperatives in twelve states have recently been announced by the Rural Electrification Administration. This brings the total since REA was formed to $520,582,301, of which $21,702,500 represents operations during the current fiscal year.

The allotments, details of which are given below, provide for the most part for extension of electric service to farms located near existing lines. No construction will be undertaken which does not meet with the approval of the War Production Board.

ALABAMA—South Alabama Electric Cooperative, Troy, $45,000.

KANSAS—Ark Valley Electric Cooperative Assn., Inc., Hutchinson, $50,000.

LOUISIANA—Claiborne Electric Refrigeration Cooperative, Inc., Homer, $2,000 for refrigerated locker facilities.

MICHIGAN—Tri-County Electric Cooperative, Portland, $100,000 for purchase and installation of 1,200-kw. diesel generating unit.

MISSOURI—Mt. Vernon Electric Refrigeration Cooperative, Inc., Mt. Vernon, $7,000 for refrigerated locker facilities.

MONTANA—Beartooth Electric Cooperative, Inc., Red Lodge, $130,000; Big Horn County Electric Cooperative, Inc., Lodge Grass, $50,000.

NORTH CAROLINA—Davie Electric Membership Corp., Mocksville, $25,000.

SOUTH CAROLINA—Edgefield Electric Refrigeration Cooperative, Inc., Edgefield, $10,000 for refrigerated locker facilities.

TENNESSEE—Caney Fork Electric Cooperative, Inc., McMinnville, $55,000.

TEXAS—Texas Power Reserve Electric Cooperative, Inc., Austin, $200,000 to facilitate materials procurement; Lyntegar Electric Cooperative, Inc., Tahoka, $75,000; Wharton County Electric Cooperative, Inc., El Campo, $75,000 for service extensions and purchase and rehabilitation of office building; Rusk County Electric Cooperative, Inc., Henderson, $40,000.

VIRGINIA—Central Virginia Electric Cooperative, Lovingston, $25,000.

WISCONSIN—Oconto Electric Cooperative, Oconto Falls, $100,000.

Construction Contracts Approved

MINNESOTA—Dakota County Electric Cooperative, Farmington, contract to S. H. Reither, Aitkin, Minn., 8.69 miles of line; labor and materials, $7,317.

MISSISSIPPI—Southern Pine Electric Power Assn., Taylorsville, contract to Collins Construction Co., Collins, Miss., 45 miles of line; labor and materials, $31,134.

MISSOURI—Mt. Vernon Electric Refrigeration Cooperative, Inc., Mt. Vernon, contract to M-P Construction Co., Carthage, Mo., locker plant building, $17,700; contract to Philips & Co., Columbia, Mo., installation of insulation, refrigeration and lockers, $13,750.

MONTANA—Vigilante Electric Cooperative, Dillon, contract to D. M. Manning, Hysham, Mont., 12.5 miles of line; $12,588.

NORTH CAROLINA—Surry-Yadkin Electric Membership Corp., Dobson, contract to Rockingham Construction Co., Harrisonburg, Va., 8.26 miles of line; labor only, $1,631.

OREGON—Benton-Lincoln Electric Coop-

SOLID SHANK
The Strongest Known Shovel

- The Sturdee *Solid Shank* Telegraph Shovel is forged in one piece from a solid bar of steel.

It is exclusive in construction —the strongest shovel known.

America's largest shovel users —railroads, mills, mines—specify, use and universally acclaim Solid Shank as first in utility, service life and economy.

Every light, power, and communications user who has tested this shovel now standardizes on Sturdee Solid Shank—they will have no other.

Reduced costs will follow if you specify Sturdee Solid Shank for all telegraph shovels.

STURDETOOLS
a TRUE TEMPER PRODUCT

Cross-section at right illustrates the solid shank, one piece construction of Sturdee Telegraph Shovels. 22 inch, straight handle socket. 13 gauge, heat treated blade. XX grade hickory or ash handle, sanded and waxed. Length 6 feet to 12 feet.

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Insulation Resistance Tester

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No hand cranking, no leveling, no shocks to the operators. Wide range 0-200 megohms covering values usually encountered in general testing are instantly available from a self-contained power source providing a constant potential of 500 Volts D.C. Available in this one compact instrument are a convenient Ohmmeter scale as well as A.C. and D.C. voltage ranges up to and including 600 volts full scale. Other models with 1,000 volts D.C. potential also available.

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are designed for specific uses involving unusual ranges or operating conditions. WRITE for full information at your earliest opportunity.

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ASSOCIATED RESEARCH, Incorporated

221-C So. Green St. Chicago 7, Ill.

erative, Inc., Corvallis, contract to Tice Electric Co., Portland, Ore., 52 miles of line; labor and materials, $57,997.

SOUTH CAROLINA—Laurens Electric Refrigeration Cooperative, Inc., Laurens, contract to C. G. Shockley Construction Co., Columbia, S. C., furnishing of complete locker plant less steel lockers and processing equipment; $29,680.

TEXAS—Stamford Electric Cooperative, Inc., Stamford, contract to Teague and Goodman, Sherman, Texas, 53 miles of line; labor and materials, $34,080.

WASHINGTON—Benton Rural Electric Assn., Prosser, contract to Electric Smith, Spokane, Wash., 42.2 miles of line; labor and materials, $45,874.

WISCONSIN—Oakdale Cooperative Electric Assn., Oakdale, contract to L. G. Arnold, Inc., Eau Claire, Wis., 62.1 miles of line; labor only, $23,449.

•

Appliance Outlets Completed by G.E.

Establishment of General Electric Co.'s post-war distributing organization for major appliances has been completed, C. R. Pritchard, general sales manager of the appliance and merchandise department, has announced.

The department will have about 60 wholesale distributing outlets for G-E refrigerators, ranges, water heaters, home laundry equipment, dishwasher, sinks and kitchen cabinets. These distributors, operating in assigned trading areas, will maintain sales organizations and local warehouse stocks at more than 125 points, and will be prepared to serve the retail dealers in every city and town in the United States, Hawaii and Alaska.

Better than 50 percent of the distributing outlets will be independent wholesalers, many of whom have been with G.E. since the General Electric refrigerator was first introduced in 1927. General Electric will operate its own wholesale distributing branches in nine major markets. Seven of them, located in New York, Newark, Cincinnati, St. Louis, Pittsburgh, Los Angeles and Philadelphia are new. The General Electric Supply Corp. will continue as a wholesale distributor of G-E's major appliances in about the same number of markets as before the war.

•

"Forward March to Market"

As part of its program in assisting dealers in their post-war planning, Landers, Frary & Clark is introducing as part of its "U" Plan for Better Living program, a new brochure giving its dealers and distributors an "inside" on the stupendous post-war planning program now underway. "Forward March to Market" is the stimulating title of Universal's brochure.

When You Want Maximum Blanket Utility and Safety

The *Surety* SLOT-TO-CENTER

A more practical and more useful blanket

For either primary or secondary line applications the slot-to-center feature blanket provides more convenience, top safety, and increased general use. Designed by Surety in cooperation with leading utility electrical engineers, the slot-to-center blanket has been enthusiastically accepted for covering spool and secondary wires, switches, transformers, dead ends, etc. A trial in field use will prove to you the increased advantages and economy of this superior blanket.

Typical Transformer Application

Here's the slot-to-center in use covering a transformer. The convenient 45" x 45" size makes it easily adaptable.

Typical Secondary Wire Application

Slot-to-center blanket inserted back of secondary spool—pinned at bottom. At spool top blanket is heavily reinforced.

→WRITE FOR DESCRIPTIVE LITERATURE ON ALL SURETY LINEMAN SAFETY EQUIPMENT *TODAY*

THE *Surety* RUBBER COMPANY
CARROLLTON, O.

LETTERS TO THE EDITOR

A Suggestion for Utility Taxation

To the Editor of ELECTRICAL WORLD:

May I contribute a thought inspired by the editorial entitled "Where Tax Discrimination Lies," in your November 25 issue?

Of the excuses given for taxation we have:

1. A man produces wealth; this should be discouraged.
2. He consumes something; therefore he can afford to contribute to the support of the political boys.
3. He has something left; taxation can provide a remedy.

Your editorial supports the second excuse.

You seem to infer—perhaps I am unjust—that the customers of publicly owned utilities should be called upon to pay a tax because those of the privately owned utilities have that item in their service bills.

Would it not be more wise to abolish the taxation of the privately owned utilities? That would put them at least on a theoretical quality with those publicly owned. The competition of the two systems would at least be on equal terms, and might show conclusively the merit of our now fashionably questioned "private enterprise."

Never advocate equality of shackles. Freedom is the desirable goal.

Incidentally, in that headline, what did you mean by "lies"? I am, with all good nature,

Henry L. T. Tideman
Chicago, Illinois.

•

Transformer Voltage Designations

To the Editor of ELECTRICAL WORLD

The last paragraph of my article "Serve 2,300-V. Load From a 4,160-V. Bus" that appeared in ELECTRICAL WORLD of February 3, 1945, page 84, is brought about by the fact that NEMA standards have been changed during the years. I have used both 240/480 and 240x480 where formerly only the slant (/) was used. The old standards required that transformers with low voltage of 120/240 (up to a certain size) shall be suitable for series, multiple or 3-wire service; while those with low voltage of 240/480 need be suitable for only series or multiple service. Thus, it was open as to whether these 240/480's would operate 3-wire. For standardization in their own assembly departments, some manufacturers built many 240/480-volt units suitable for 3-wire because it was easier to do so; and such transformers had wider application than if they just met the NEMA standard.

Now the new NEMA standards come along (Publication No. 42-73; Rule TR8-16) and say that where a winding is designed for series and multiple connection, these voltages shall be separated by "x". This is just like the old / in 240/480 which leaves 3-wire service optional. But under the example which they quote, they definitely state that 240x480 transformer is *not* suitable for 3-wire service. (This is Par. "Series-Multiple Only" Page 35).

Also the "Series, Multiple and Three-Wire" paragraph under the same rule can cause confusion. It shows that the slant / signifies a winding suitable for series, multiple or 3-wire service, for example 120/240. Therefore, by this rule one would expect a transformer marked 250-kva. 2400-120/240 to be suitable for 120-volt multiple connection, but that is not necessarily true since this is in conflict with Note "d" of Table III of the NEMA standards book.

Thus, while the manufacturer can supply transformers suitable for the described connection, the consumer cannot look at the nameplate of some old or new transformers and tell whether they will perform without reconnecting some coils inside.

G. A. Wright
Maloney Electric Company
Indianapolis, Indiana

•

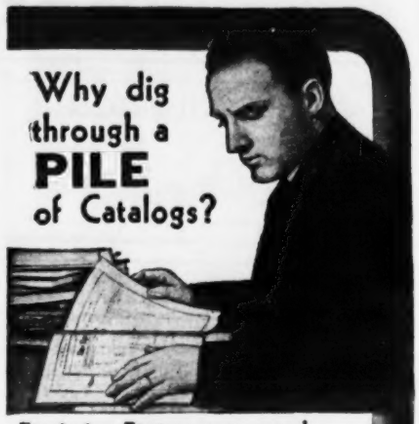
Service Calls

To the Editor of ELECTRICAL WORLD:

In the news issue of ELECTRICAL WORLD, December 16, page 4, there is a very true and amusing brief, "The Gas Company." There is a good reason why the customer wants the gas company.

We took over a small gas plant here in December, 1940, about one-fourth the size of our electric system as regards the number of customers. Our plant is as good as the average plant, but the service calls for the small gas plant average about four times as many calls as we have for electric service troubles Of course, independent electricians handle numbers of electrical trouble calls, but the ratio of the calls between the gas and electric systems is perfectly illustrated in your "Brief."

F. W. Chapman,
Superintendent of Public Works,
Greenwood, S. C.



Find the Fitting you need—quickly—in the COMPLETE line

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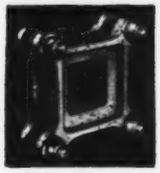
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BOOK REVIEWS

Meteorology. George J. Brands. Published by McGraw-Hill Book Company, 235 pages, illustrated. Price $2.50.

Authored by an airways chief meteorologist, the sixteen progressive lessons treat the rudiments of weather in much the approach that a utility system operator would best appreciate. It defines the terms and the analyses of the meteorologists in keeping with the new school of thought that makes forecasts rest on the physical properties and propensities of air masses. The closing chapter discusses the science of forecasting from synoptic charts, ending with a list of 17 simply expressed empirical rules. Appendices include an extensive glossary meteorological tables, color views identifying clouds and numerous pocket charts.

Arc Welding Engineering and Production Control. Walter J. Broking. Published by McGraw-Hill Book Company. 347 pages, illustrated. Price $4.00.

Mass production welding is most effective in achieving acceptable, economic results if properly organized in design, engineering and control of the associated functions of parts preparation, supervision, inspection and finishing. This is the theme to which the book is addressed. It deals with the decision on how much to weld, how to educate and supervise the welder, choose the electrode, fix the sequence of steps and best type of jigs and fixtures to adopt. The illustrations and examples are largely from the operations of R. G. Le Tourneau, Inc., for which the author is director of testing and research.

Vibration Analysis. N. O. Myklestad. Published by McGraw-Hill Book Company. 303 pages, illustrated. Price $3.50.

Mathematical implementing of the analysis of vibration here starts with the kinematics, vibratory motion, undamped vibrations and forced vibration before taking up the isolation of vibration by springs. There is next a discussion of critical speeds and of viscous damping. Torsion and bending are likewise treated with numerical examples. The final third deals primarily with aeronautical manifestations after having set up the fundamentals of vibration wherever encountered. The author is reputed to have developed many of the techniques.

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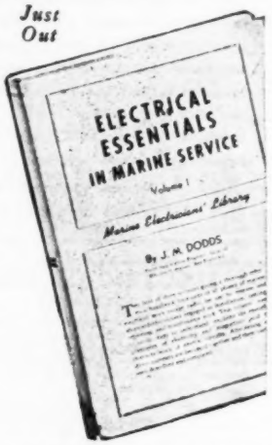

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1—	1200	Whse.	Compen.	550	600/720
1—	800	G.E.	MPC	660	600
1—	625	G.E.	MPC	500	160
1—	600	G.E.	MPC	600	650/900
1—	500	G.E.	MPC	230	900
1—	500	Whse.	Compen.	250	800/720
1—	350	G.E.	MPC	220	450
1—	300	G.E.	MPC	230	275/550
1—	250	Al. Ch.		230	525
2—	200	Whse.		230	400
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1—	150	G.E.	MPC	230	250/450
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1—	50	G.E.	RC-19	230	400/1200

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1—	1050	G.E.	3	WCTH	11000x445
4—	525	G.E.	1	HJDD	2300x445
4—	500	Pitts.	1	OISC	13200x2300
3—	333	Moloney	1	C-OISC	22000/11000x2300/575
2—	333	Whse.	1	OISC	2300x460
2—	333	Pitts.	1	OISC	2400x220
3—	300	G.E.	1	H-RP	13200x575/1150/2300
1—	300	Pitts.	3	ODSC	4150x208/120
3—	300	Packard	1	OISC	2200x220/440
3—	200	G.E.	1	H-IDD	2400x115/460
3—	150	G.E.	1	HKS	440x115/230

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1—105 KW GE 70 V. Gen. d.c. to 160 HP—2300 V.
1—100 KW GE 125/250 V. Gen. d.c. to 150 HP—440 V.
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1—	1000	G.E.	900	600	13200
1—	1000	Whse.	900	600	11000
1—	750	G.E.	1200	600	2300
1—	750	Whse.	720	250	6600/2300
1—	500	Whse.	1200	600	13200/2300
1—	375	G.E.	1200	250	6800/2300
2—	300	G.E.	1200	600	2300

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1—	600	Al. Ch.		2200	720
1—	150	Whse.		4000	1800
1—	100	Whse.	G	2200	1800
1—	75	G.E.	TS-7556	220/440	600

Slip Ring

1—	1200	CR.-Wh.	801-Q	220	257
1—	800	Al. Ch.		440	514
1—	600	G.E.	MT	550	720
2—	600	G.E.	IP	440/2200	720
1—	450	Whse.	CW	2200	575
1—	400	G.E.	IP	440/2200	600
1—	400	Al. Ch.		2300	600
1—	400	G.E.	IP	2200	257
1—	300	G.E.	IM	2300/4000	257
1—	250	G.E.	MT	4000/2300	257
1—	200	Whse.	CW	2200	514
1—	200	G.E.	IM	440	600
1—	150	Whse.	CW-772C	2200	1160
1—	150	G.E.	IM	2200	575

Squirrel Cage

1—	300	Whse.	CS	550	880
1—	200	G.E.	IK	2300	600
1—	175/112	G.E.	IK	440	900/720
1—	125	Whse.	CSJ	220/550	1158
1—	100	G.E.	IE-13	2200	1800

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1—	2000	Whse.		2400	720
1—	1000	G.E.	ATI	2200/3800	1900
1—	900	G.E.	ATI	2200/6600	1200
1—	750	G.E.	ATI	220/440	900

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1—400 H.P., 220 volt, 1200 RPM, Westinghouse squirrel cage.
1—350 H.P., 300 RPM, 440 volt, General Electric slip ring
1—250 H.P., 600 RPM, 2200 volt, General Electric slip ring
1—200 H.P., 1800 RPM, 220 volt, General Electric slip ring
1—200 H.P., 600 RPM, 550 volt, Westinghouse slip ring
1—200 H.P., 600 RPM, 440 volt, Crocker-Wheeler slip ring
1—150 H.P., 1800 RPM, 440 volt, General Electric squirrel cage
3—150 H.P., 1800 RPM, 220 volt, Westinghouse slip ring
2—150 H.P., 1200 RPM, 2200 volt, Westinghouse squirrel cage
1—150 H.P., 400 RPM, 440 volt, General Electric squirrel cage
1—125 KVA, 900 RPM, Westinghouse synchronous
1—125 H.P., 600 RPM, 220 volt, Westinghouse slip ring
3—100 H.P., 720 RPM, 440 volt, General Electric slip ring
1—100 H.P., 600 RPM, 2200 volt, General Electric slip ring
1—100 H.P., 450 RPM, 440 volt, General Electric squirrel cage

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2—25 KW, 125 volt, direct current
1—30 KW, 125 volt, direct current

1— 90 H.P., 400 RPM, 550 volt, Crocker-Wheeler squirrel cage
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1— 75 H.P., 720 RPM, 440 volt, Westinghouse slip ring
1— 60 H.P., 1200 RPM, 440 volt, General Electric slip ring
1— 50 H.P., 1800 RPM, 220 volt, Fairbanks-Morse slip ring
1— 50 H.P., 900 RPM, 440 volt, Generel Electric slip ring

MOTORS—D.C. 230 VOLTS

2—450 HP, 400 RPM, G.E.
1—350 HP, 760 RPM, Electro Dynamic.
1—150 HP, 750 RPM, Electro Dynamic.
1—150 HP, 500 RPM, General Electric, MPC.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1— 50 HP, 750 RPM, Westinghouse, type SK.
1— 50 HP, 700 RPM, Crocker-Wheeler.
1— 40 HP, 775 RPM, Westinghouse.

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2—400 KVA, G.E., 4155-240/480 v., Scott taps.
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3—100 KVA, General Electric, 2300-220/110 volts.
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2—15 KVA, G.E., 2300-115/230 volts.

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1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—35 HP, 500/1500 RPM, Westinghouse.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—30 HP, 400/1200 RPM, General Electric.
2—25 HP, 300/990 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—12/18 HP, 350/1200 RPM, Electro Dynamic.
2—11½ HP, 500/1500 RPM, Westinghouse, type SK.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

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25—Westinghouse type U recording voltmeters.

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1—300 KW, G.E., 3 ph., 60 cy., 220 volt, cond.

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New York Phone: LOngacre 5-3227 — 1602 53rd ST., NORTH BERGEN, N. J. — New Jersey Phone: UNion 3-2600

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(Continued from opposite page)

SUPERINTENDENT of Utilities. Thirty years experience in public and private operation. Registered professional engineer. Can furnish excellent references. Now employed by municipality in northwest. PW-820, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

EXECUTIVE ASSISTANT or territory manager: 23 years field experience in utility business, 7 in accounting and 16 as territory operating manager. Experience also included Municipal franchise and contract negotiation and public relations work. Age 46, married, good health, references. Available on reasonable notice. Middle West preferred. PW-821, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

INVESTMENT ANALYST, twenty years experience, established reputation in field of public utility securities, wishes to explore possibilities of employment with a utility company. Would be especially valuable in financial department, public relations or stockholder relations. PW-822, Electrical World, 330 W. 42nd St., New York 18, N. Y.

DESIRE Connection with electric utility, 11 years experience supervision transformer repairs substation maintenance and construction and other utility work. Past draft age. Interested in anything permanent only. Married, one child. PW-823, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

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PACIFIC COAST representation. A firm consisting of three partners who possess extensive business and merchandising experience on the Pacific Coast, particularly in the San Francisco area, is desirous of contacting manufacturers who contemplate renewing or establishing agencies on the Pacific Coast. Satisfactory references can be furnished. Write King, Shea & Poston, 604 Mission St., San Francisco 5, Calif.

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We have several thousand transformers in stock for prompt shipment, and invite your inquiries.

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★ **These companies have supplied additional buying information on their products in the 1945 edition of the Electrical Buyers' Reference**

MULTUMITE SWITCHGEAR For CENTRAL STATIONS

View of a 440-volt, withdrawal type Multumite switchboard recently furnished a large Eastern Utility for central station auxiliary service.

MULTUMITE ADVANTAGES INCLUDE:

1 **SELF-ALIGNING SEPARABLE CONTACTS** . . . for dependable service. No springs in current path; no pigtails.

2 **ROTARY-TYPE REMOVABLE HANDLES** . . . for fast, positive, emergency operation of enclosed circuit breakers which are normally operated electrically.

3 **WELDED STEEL FRAME** . . . a strong, rigid steel structure maintains proper alignment.

4 **BONDERIZED STEEL** . . . metal is treated so that finish will withstand severe service without cracking or peeling.

5 **FLANGED DOORS** . . . formed and welded into sturdy structural units. Panels at sides, top and back are of similar construction.

6 **CONCEALED HINGES** . . . permit door to be opened a full 100 degrees.

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8 **12 FINISHING OPERATIONS** . . . cleaning, spray priming, baking, two spray coats, two bakings, pneumatic sanding and two coats of enamel, both baked.

When considering the selection of switchgear, it will pay you to keep these Multumite advantages in mind. They are indicative of the careful design and painstaking construction that enter into every detail of every product that bears the I-T-E mark.

For complete description of Multumite Switchgear ask your nearest I-T-E representative for Catalog 6002 or write to I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Phila. 30, Pa.

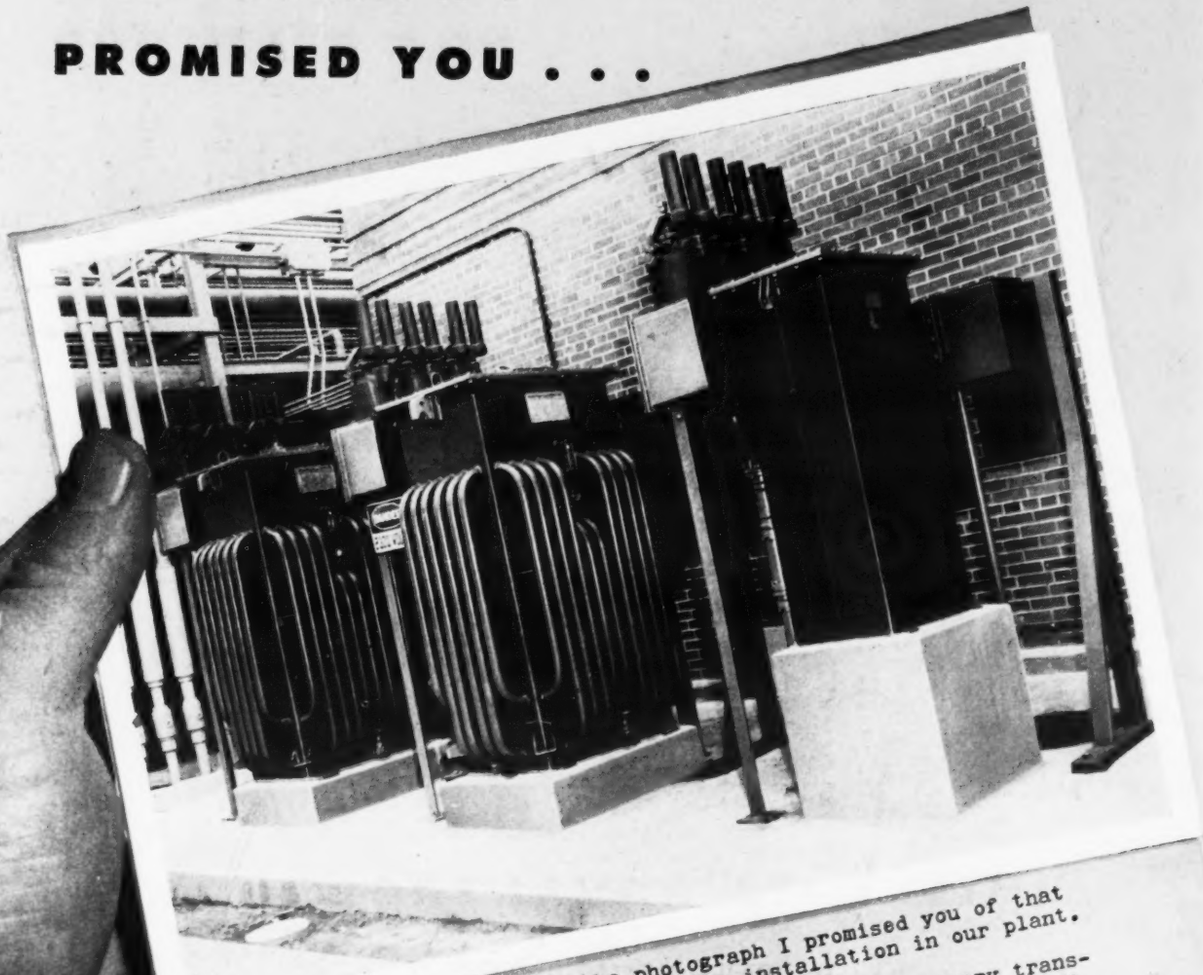
I-T-E

REPRESENTATIVES IN ALL PRINCIPAL CITIES

AIR SWITCHGEAR

ARMY NAVY I-T-E

DEAR JIM: HERE'S THE PHOTOGRAPH I PROMISED YOU . . .



and incidentally, here's the photograph I promised you of that most recent Kuhlman OISC Transformer installation in our plant.

These are three-phase, 60 cycle, 2400 volt primary transformers. The two at the left are 300 KVA and the third is 100 KVA. All of them are doing a mighty efficient job for us here at the refinery.

I'm sure their construction has a lot to do with their performance, Jim. For example, I know that tap changers, tap leads, frame, the case and all other component parts of these transformers are built to withstand stress and strain of constant heavy loads. We've found from experience that Kuhlman Transformers give uninterrupted, trouble-free service. When you need transformers, I think you ought to get in touch with Kuhlman.

Sincerely,

KUHLMAN ELECTRIC COMPANY

BAY CITY, MICHIGAN